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[54] **CLIENT-SIDE ASYNCHRONOUS FORM MANAGEMENT**

[75] Inventors: **Hung-yang Chang**, Yorktown Heights; **Norman H. Cohen**, Spring Valley, both of N.Y.; **Richard Allen Floyd**; **Barron Cornelius Housel, III**, both of Chapel Hill, N.C.; **David Bruce Lindquist**, Raleigh, N.C.; **Steve Mastrianni**, Unionville, Conn.; **Marshall Shapiro**; **Carl D. Tait**, both of New York, N.Y.

[73] Assignee: **International Business Machines Corporation**, Armonk, N.Y.

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[52] **U.S. Cl.** **709/203**

[58] **Field of Search** 709/200, 201, 709/203, 217, 218, 219, 227

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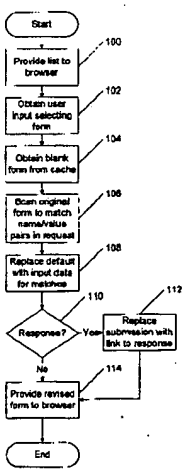
Primary Examiner—Moustafa M. Meky

Attorney, Agent, or Firm—Myers Bigel Sibley & Sajovec; Jeanine S. Ray-Yarletts

[57] **ABSTRACT**

Methods, systems and computer program products are provided for communicating with a web browser executing on a remote/mobile processing system which is temporarily and intermittently connected to a second computer. According to the present invention, requests from the web browser to a server application accessible to the second computer are stored in a persistent request queue at the remote/mobile processing system. An interim response is provided to the web browser in response to the request from the client application. The stored request may be recalled to allow user modification of the stored request prior to the request being provided to the second computer for transmission to the server application.

39 Claims, 5 Drawing Sheets



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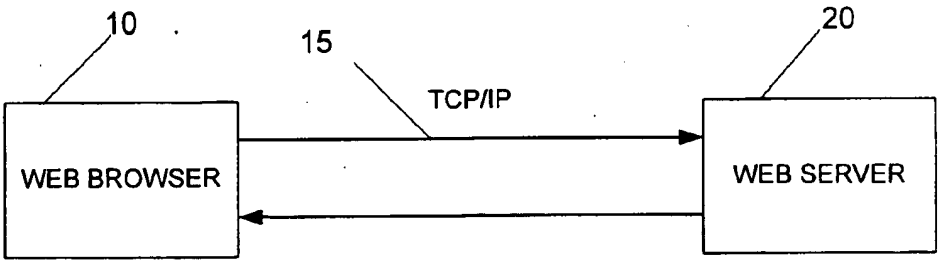


FIGURE 1 - PRIOR ART

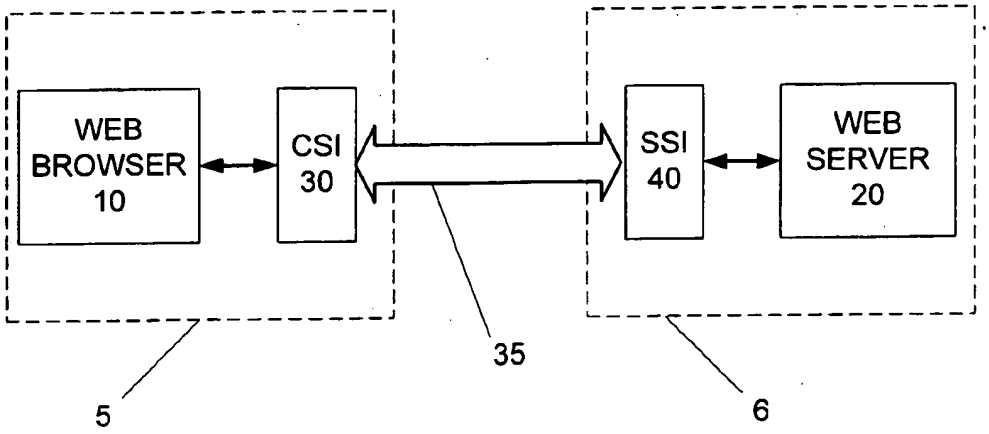


FIGURE 2

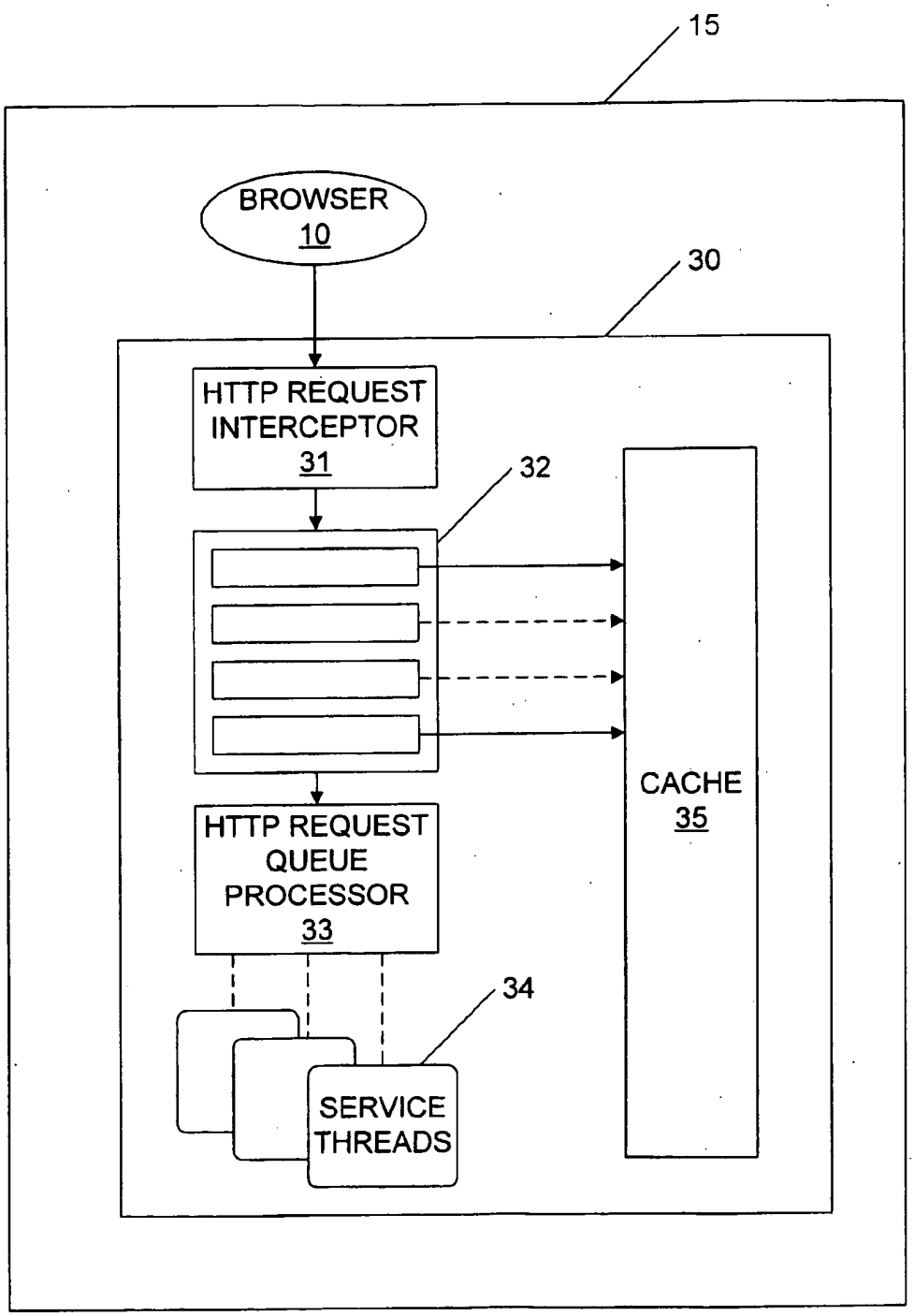
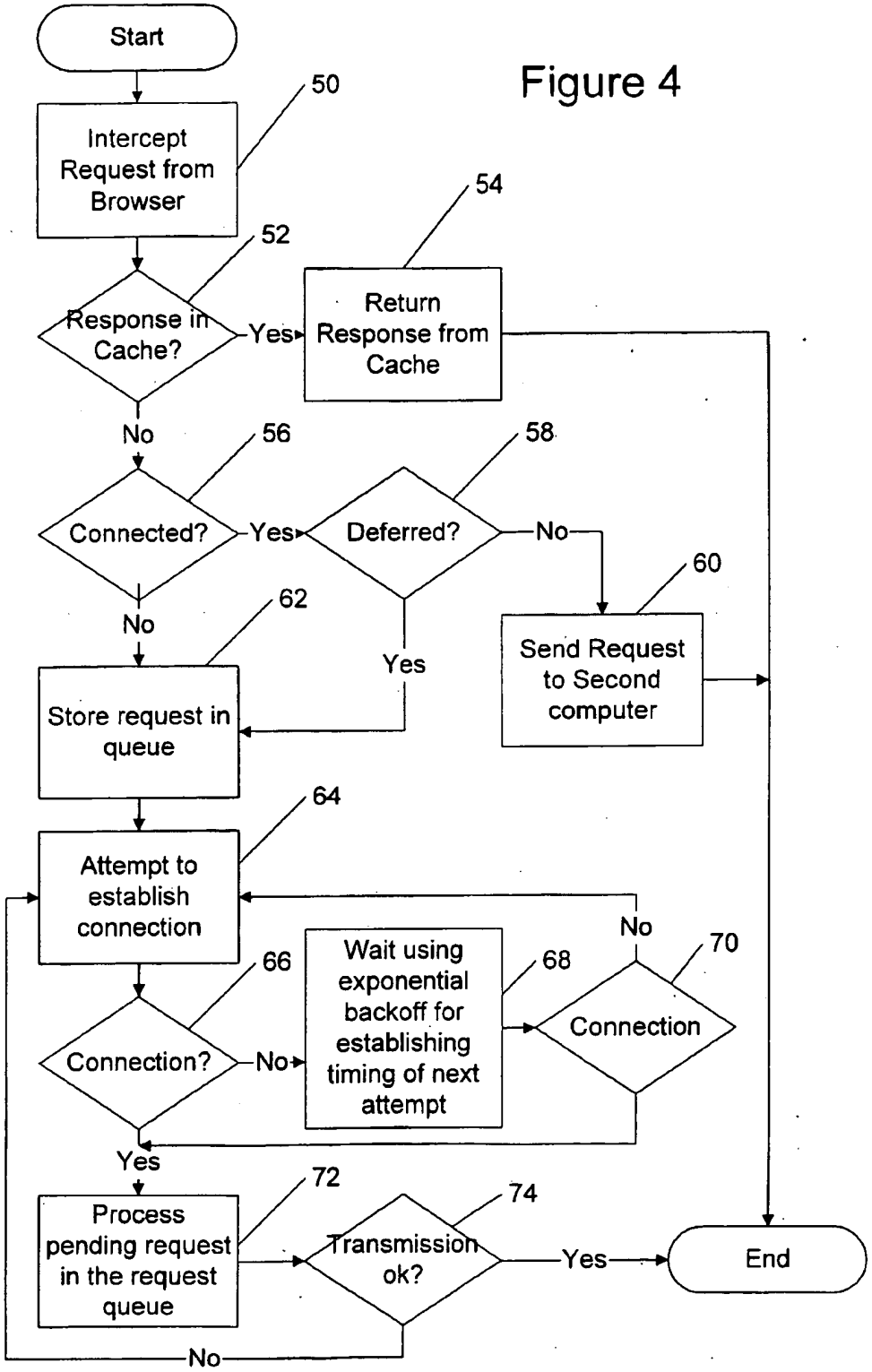

15
BROWSER
10
30
HTTP REQUEST
INTERCEPTOR
31
32
CACHE
35
HTTP REQUEST
QUEUE
PROCESSOR
33
34
SERVICE
THREADS

Figure 3

Figure 4


Start
Intercept Request from Browser
50
Response in Cache?
52
Yes
Return Response from Cache
54
No
Connected?
56
Yes
Deferred?
58
No
Send Request to Second computer
60
No
Yes
Store request in queue
62
Attempt to establish connection
64
No
Connection?
66
No
Wait using exponential backoff for establishing timing of next attempt
68
Connection
70
Yes
Process pending request in the request queue
72
Transmission ok?
74
Yes
End
No

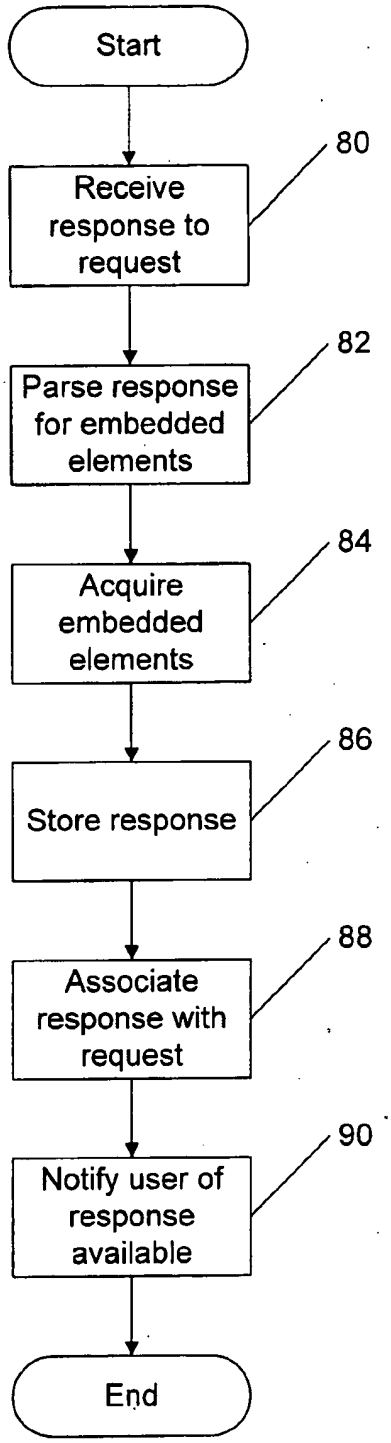

Start
Receive response to request
80
Parse response for embedded elements
82
Acquire embedded elements
84
Store response
86
Associate response with request
88
Notify user of response available
90
End

Figure 5

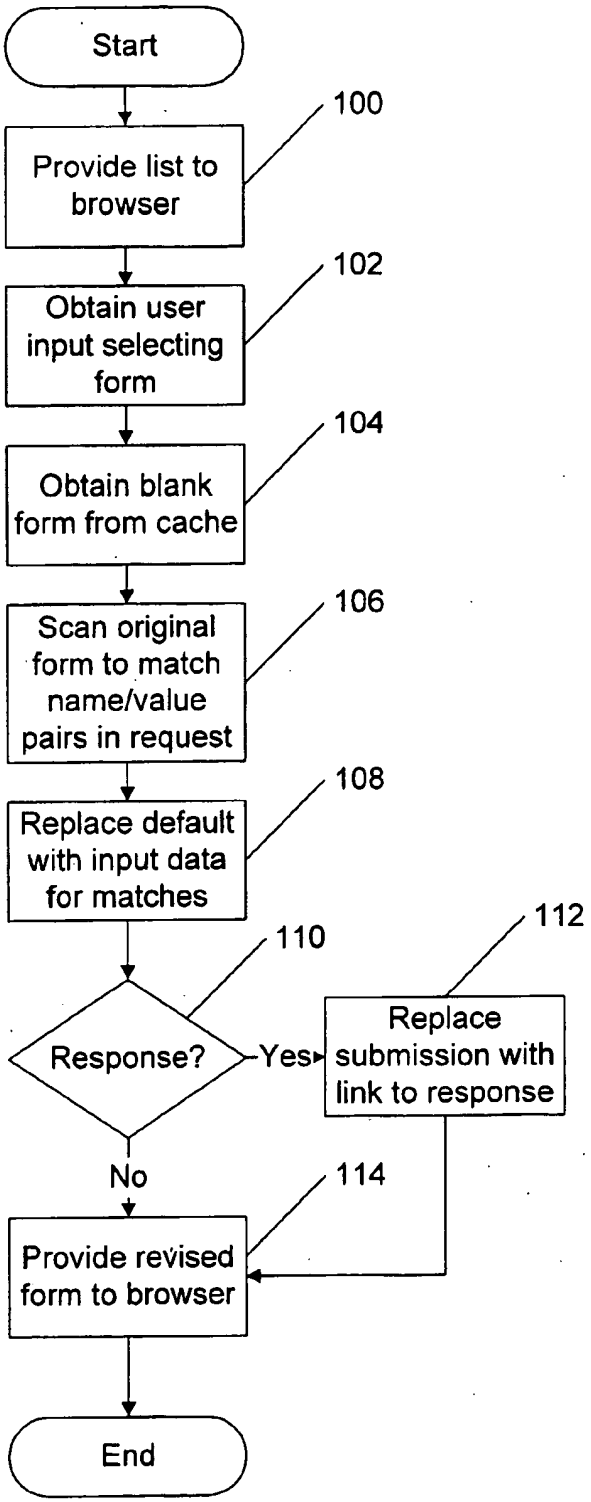

Start
100
Provide list to browser
102
Obtain user input selecting form
104
Obtain blank form from cache
106
Scan original form to match name/value pairs in request
108
Replace default with input data for matches
110
Response?
Yes
112
Replace submission with link to response
No
114
Provide revised form to browser
End

Figure 6

CLIENT-SIDE ASYNCHRONOUS FORM MANAGEMENT

FIELD OF THE INVENTION

The present invention relates remote/mobile computing, and more particularly to remote/mobile computing using the web browser/web server communication model.

BACKGROUND OF THE INVENTION

The recent publicity and emphasis on the "information superhighway" has increased awareness and acceptance of the Internet as a mass communication media. This broad based recognition of the Internet as a viable media for communication and interaction across multiple networks has also created a large established user base built upon the Internet standardized protocols for interaction between computer networks.

The paradigm for the Internet is that of a client-server relationship where Internet clients (browsers) communicate with Internet servers. To provide greater access to the Internet the communication protocols and languages utilized by the clients and servers have become standardized. These protocols include the Hyper-Text Transfer Protocol (HTTP), which is the communication protocol used for communications between clients and servers, and the Transfer Control Protocol/Internet Protocol (TCP/IP) the TCP portion of which is the transport specific protocol for communication between computers or applications. Also standardized is the language in which clients and servers communicate which is called Hyper-Text Markup Language (HTML).

In the context of the World Wide Web client/server applications the client may be a web browser which acts as the user interface. The web browser sends user requests to the appropriate web server and formats and displays the HTML data returned from the web server. The web browser also evaluates the HTML data to determine if there are any embedded hyper-link statements in the HTML data which would require subsequent browser requests which would then be initiated by the browser. A web server acts as the server for the client and processes the web browsers requests and returns the requested response as an HTML data portion of a HTTP data stream.

The basic communication structure for an Internet based system is depicted in FIG. 1. In FIG. 1 a web browser **10** communicates with a web server **20** over a communication link **15**. This communication link is typically a local area network connection, wide area network connection, a connection over telephone lines or a combination thereof. The web browser **10** communicates with the web server **20** using TCP/IP. For the majority of Internet communications a web browser communicates with a web server using the generic communication protocol HTTP which is transmitted between the web browser and the web server over the TCP/IP link between the web browser and the web server. The actual data transferred between the web browser **10** and the web server **20** are HTTP data objects (e.g. HTML data) as described above. The web server **20** may be a proxy which receives web browser communications from a number of web browsers and routes them to the appropriate server.

The popularity of the web browser/web server and their common information and transport protocols, HTML and HTTP, has lead to rapid acceptance of web technology as a universal interface for network access to information. Furthermore, because the protocols and language for communication between web browsers and web servers are standardized the communication protocols and language will be the same whether a user is using Netscape Navigator™, NCSA Mosaic™, WebExplorer™ or any other web browser as their web browser to access network information. Therefore, the large installed user base for web browsers combined with the connectivity of the Internet and the ease of writing web application servers using the HTTP defined Common Gateway Interface (CGI)make web technology very attractive for a large class of forms-based applications.

At the same time that the Internet was growing in popularity and acceptance, mobile computing was also increasing in popularity. The use of laptops, notebooks, Personal Digital/Communication Assistants (PDAs/PCAs) and other portable devices has lead to an increase in demands for wireless communications. Wireless wide area networks, cellular communications and packet radio, however, suffer from common limitations if used in a web context. The high cost per byte of communications, slow response time, low bandwidth and unreliability all hamper use of wireless technology for the stateless communication protocol of the World Wide Web. Also, because the web protocol is stateless the amount of data per request and the number of communication requests transferred over the wireless connection are larger than would be necessary if the communication were not self contained.

Furthermore, the underlying mechanisms and protocols of Web browsing were developed with a traditional network model in mind. These mechanisms were developed based on the tacit assumption that the computers involved were connected via high-bandwidth, inexpensive, reliable links. However, in contrast to a wired LAN or WAN environment, mobile links are typically low-bandwidth, costly, and unreliable. Some mobile connections are less burdensome than others—for example, a simple dialup modem is both faster and cheaper than packet radio—but all are dramatically slower than their LAN counterparts. Mobile connections are also less reliable: dropped connections are not uncommon due to signal degradation, blockage, and other problems. Thus, applications such as web browsers that were targeted for a LAN environment often perform very poorly in a network-constrained setting.

Furthermore, the mobile environment raises the issue of disconnected operation. Standard Web browsing—as well as many existing networked applications—assume that disconnection is a comparatively rare error case. Operations typically fail when the client is disconnected from the server.

Weak connectivity and the possibility of disconnection lead to yet a third aspect of the mobility problem: the dynamic nature of a user's connectivity. At different times, a single user may be strongly connected (LAN), weakly connected (cellular or other mobile link) or disconnected.

Several factors contribute to poor usability and reduced user productivity when using browsers in a resource-constrained or unreliable communication environment typified by wireless communication. First, the browser protocol is synchronous, which means that users must wait until a request completes before another request can be made. When the delay is long due to slow wireless transmission, congested Internet or intranet traffic, or overburdened Web servers, users may become frustrated and unproductive.

Second, the natural burstiness of the synchronous request/response scheme may become a significant problem over a slow link. Over a wired LAN, server response time is usually the primary concern, but in a wireless environment, bandwidth and latency are typically the dominating factors.

(Latency on a packet radio network can be on the order of several seconds.) Third, the usual synchronous request/response model does not work at all in the face of voluntary or involuntary disconnection. If a request cannot be satisfied immediately, an error code is typically returned and the user must explicitly retry the request at a later time.

In light of the above discussion, a need exists for improvements in the web browser/web server operation in the mobile computing environment which may be characterized by varying levels of connection performance and reliability.

SUMMARY OF THE INVENTION

In view of the above discussion, it is an object of the present invention to reduce the impact of the synchronous nature of browser communication in a weakly connected or disconnected environment.

A further object of the present invention is to overcome browser limitations in a remote or mobile environment where transmission time, latency or other communication limitations reduce responsiveness of browser/server communications.

Still another object of the present invention is to provide browser functions in a mobile environment where the nature of the environment is transparent to a user.

Still another object of the present invention is to make connection status transparent to browsers such that existing browsers may be utilized in a mobile environment.

These and other objects of the present invention are provided by methods, systems and computer program products for communicating with a web browser executing on a remote/mobile processing system which is temporarily and intermittently connected to a second computer. According to the present invention, requests from the web browser to a server application accessible to the second computer are stored in a persistent request queue at the remote/mobile processing system. An interim response is provided to the web browser in response to the request from the client application. The stored request may be recalled to allow user modification of the stored request prior to the request being provided to the second computer for transmission to the server application.

Furthermore, the stored request can be transmitted to the second computer when the remote/mobile data processing system is connected to the second computer and a response to the request from the server received through the second computer. The response to the request may be stored at the remote/mobile processing system associated with the stored request. The stored response may also be provided to the client application.

By storing requests in a request queue and providing an interim response to the web browser, asynchronous operation of the web browser may be achieved. Furthermore, by storing the requests until a connection is established, the requests may be recalled and edited to allow a user to change the request before it is processed. Thus, the present invention overcomes the limitations of weak connectivity. Furthermore, in slow speed environments, the present invention allows a user to continue to work while communications are performed in the background.

In a particular embodiment of the present invention, a list of stored requests is provided to the web browser for presentation to a user. User input is accepted to select one of the stored requests in the list of stored requests and the associated response to a selected one of the list of stored requests is provided to the web browser based upon the user input.

In a further embodiment, the user is notified of the availability of the received response when the response is received by the remote/mobile data processing system and the response provided to the web browser if the user requests the response.

In stall a further embodiment of the present invention, an HTML form associated with the request and the user input associated with the request are stored. The stored user input is associated with the stored HTML form. Thus, by storing the original form that created the request and the user input of the request the request may be recalled by the user for modification or verification. Such a recall may be accomplished by providing a list of stored requests to the web browser for presentation to a user and accepting user input to select one of the stored requests in the list of stored requests. The stored request selected by the user input may then be provide to the user in the original form that the request was generated.

The original form of the request may be generated by recalling the stored form associated with the request and the stored user input associated with the request. The recalled form and the recalled user input may then be provided to the web browser so as to recreate the form with the user input. The recalled form and user input may be combined by scanning the recalled form for named fields in the recalled form and scanning the recalled user input for name/value pairs in the user input. The default selection or user input of the named field in the recalled form may then be replaced with the value of a matching name/value pair from the user input.

In yet another embodiment of the present invention, it is determined if a response to the recalled stored request has been stored at the remote/mobile data processing system. A link to the stored response to the recalled form may then be provided so as to provide to the user a hyperlink to recall the stored response.

Furthermore, user input may be accepted to revise an original request from the web browser so as to provide a revised request based upon the original request modified by the user input. The revised request may then be stored in the request queue. The request in the request queue may optionally be replaced with the revised request.

In still another embodiment of the present invention it is determined if the remote/mobile data processing system is linked to the second computer. In such an embodiment, the requests are only stored if the remote/mobile data processing system is not linked to the second computer.

As will further be appreciated by those of skill in the art, the present invention may be embodied as a method, apparatus/system or computer program product.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of a typical web browser/web server system;

FIG. 2 is a block diagram of a web browser/web server system according to one embodiment of the present invention utilizing a client intercept and a server intercept;

FIG. 3 is a block diagram of a remote/mobile data processing system according to the present invention;

FIG. 4 is a flow chart illustrating disconnected or deferred processing operations according to the present invention;

FIG. 5 is a flow chart illustrating operations associated with receiving a response to a browser request at a remote/mobile data process system according to the present invention; and

FIG. 6 is a flow chart illustrating operations associated with revising a request according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The present invention now will be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout. As will be appreciated by one of skill in the art, the present invention may be embodied as methods or devices. Accordingly, the present invention may take the form of an entirely hardware embodiment, an entirely software embodiment or an embodiment combining software and hardware aspects.

FIG. **2** illustrates one embodiment of the present invention. As seen in FIG. **2**, a web browser **10** communicates with a client-side intercept module **30**. The web server **20** communicates with a server-side intercept module **40**. The client-side intercept module **30** then communicates with the server-side intercept module **40** over the communication link **35**. The web browser **10** and the client-side intercept module **30** may be contained in a first computer **5**. The server-side intercept module **40** and the web server **20** may be contained in a second computer **6**. The first computer **5** and the second computer **6** communicate over external communication link **35**. The first computer **5** is preferably a remote/mobile data processing system. As used herein, "remote/mobile" means "temporarily and intermittently linked", wherein temporarily means "lasting for a limited time" and intermittently means "coming and going at intervals, not continuous, or occasional." Remote/Mobile data processing systems may also include data processing systems which remotely access other systems such as over a network.

Preferably, the web browser **10** is a Internet web browser utilizing hypertext transfer protocol (HTTP) and hypertext markup language (HTML) to communicate with an Internet web server **20** which also uses HTTP and HTML. In operation, the web browser **10** would output an HTTP data stream which is intercepted by the client-side intercept module **30**. The intercept of the HTTP data stream by the client-side intercept module **30** may be accomplished through the use of the TCP/IP loop-back feature where the client side intercept module **30** resides at an IP address having a network number of 127, such as 127.0.0.1. The client-side intercept module **30** then converts or transforms the HTTP data stream into a client/server specific protocol and transmits the client/server specific data stream onto the external communication link **35**. The server-side intercept module **40** receives the client/server specific data stream and reconstructs the original HTTP data stream corresponding to the web browser originated communication. This reconstructed HTTP data stream is then transferred to the web server **20**. The web server **20** responds to the HTTP data stream in the normal manner of an Internet web server. As will be appreciated by one of skill in the art, the web server **20** may also be a proxy which allows multiple browsers to connect to the Internet.

When information is received by the web server **20** for transmission to the web browser **10**, for example, in response to a browser request for a specific URL home page, the web server **20** outputs an HTTP data stream corresponding to the communication to be sent to the web browser **10**. This web server originated communication is intercepted by the server-side intercept module **40** and transformed by a client/server specific data stream. The client/server specific data stream corresponding to the web server originated communication is then sent on the external communication link **35** from the second computer to the first computer. The client/server specific data stream is received by the client-side intercept module **30** and the original HTTP data stream corresponding to the web server originated communication is rebuilt and provided to the web browser **10**.

In a particular embodiment of the present invention, the external communication link **35** is a wireless communication link. In such a case, in order to obtain system performance which is acceptable to users, it is desirable to reduce the amount of communication over the external communication link **35** both in the frequency of the communications and in the amount of information which must be transferred over the communication link **35**. Accordingly, the present invention preferably utilizes caching, differencing, and protocol reduction techniques to minimize the amount of communication required over the external communication link **35**. These techniques are accomplished by converting the stateless or stochastic protocols of HTTP into a client/served specific protocol which utilizes information specific to the client and the server to reduce the amount and frequency of communications.

In operation, the client side intercept **30** and the server side intercept **40** are transparent to both web browsers and web (proxy) servers and, can therefore be employed with any web browser. Both the SSI **40** and CSI **30** cache graphic and HTML objects. If the URL of a browser request specifies an object in the CSI's cache, it is returned immediately as the browser response. The caching functions guarantee cache integrity within a client-specified time interval. The SSI cache is populated by responses from the requested web servers. If a requested URL received from a CSI is cached in the SSI, it is returned as the response to the request.

The present invention preferably utilizes a virtual socket system such as is illustrated in commonly assigned U.S. patent application Ser. No. 08/601,804 entitled CLIENT/SERVER COMMUNICATION SYSTEM, now U.S. Pat. No. 5,754,774 the disclosure of which is incorporated herein by reference as if set forth fully. The present invention also preferably utilizes the data reduction techniques described in commonly assigned U.S. patent application Ser. No. 08/601,753 entitled TIME COHERENT CACHING SYSTEM, now U.S. Pat. No. 5,878,213 and in commonly assigned U.S. patent application Ser. No. 08/601,903 entitled DIFFERENCING COMMUNICATION SYSTEM, the disclosures of which is incorporated herein by reference as if set forth fully, and now becomes U.S. Pat. No. 5,859,971.

While the present invention has and will be described with respect to a single web browser application and a single web server application, as will be appreciated by those of skill in this art, the benefits and advantages of the present invention may also be achieved with multiple web browsers associated with a single web server. Thus, the methods, apparatus and program products of the present invention in connection with multiple browsers each communicating with a client-side intercept module and these client side intercept modules would then communicate with the server-side intercept module of the web server or web proxy.

Furthermore, while the present invention is described herein with respect to both a client-side intercept module

and a server-side intercept module, as will be appreciated by those of skill in the art, only a client-side intercept is required by the present invention. Thus, the present invention should not be construed as limited to systems having both a client-side and a server-side intercept module.

The present invention provides for asynchronous request and response processing which permits a user to continue making requests even though previous requests have not completed. Requests are recorded internally for background processing. When requests complete, the results are saved and status is updated a synchronously. The user is (optionally) notified when requests complete and may, at any time, switch to the status page to review the status of one or more requests. The status entry for each request conveys the state of the request (not started, in process, or complete) and contains a link to the response page if the request has completed.

The present invention also provides for disconnected operation when the remote/mobile data processing system is not linked to a computer with access to a server application. Users can operate in either synchronous or asynchronous mode. In either case, when the loss of a connection is detected, or if communication is not possible (e.g., out of signal range), requests may be queued and held for later processing. When communication is re-established, queued requests are automatically processed in the background. This capability enables a user to continue to be productive offline. Furthermore, in many cases, all the pages needed for a transaction may be stored in a local cache and no communication is required. These operations will now be described with respect to FIG. **3** and the flow chart illustrations of FIG. **4** through FIG. **6**.

FIG. **3** illustrates a remote/mobile data processing system utilizing a particular embodiment of the present invention. As seen in FIG. **3**, a remote/mobile data processing system **5** includes an application such as a web browser **10** executing on the remote/mobile data processing system **5**. Requests from the browser **10** are intercepted by an HTTP request interceptor **31** and placed in a request queue **32**. The requests in the request queue **32** are processed by a HTTP request queue processor **33** which carries out the requests when a connection is established to a second computer having access to the server specified in the requests. When these requests are processed a service thread **34** is initiated for each request to carry out the request. Responses to the request are placed in the cache **35** and associated with the request from the request queue which generated the request. Such association is illustrated as a dashed line in FIG. **3**. The solid line in FIG. **3** from entries in the request queue to the cache represents the association of the request entry with the form used to create the request. Such an association allows for editing of requests by a user even after the requests have been generated. Optionally, both the requests and the responses may be associated with the entries in the queue so that both the request and the response may be provided to a user.

The request queue **32** is a list of requests that have been received from the browser by the HTTP Request Interceptor **31**, along with status and control information. Each request element includes all of the information received from the browser (the HTTP headers and any body). This allows the request to be replayed to the network at a later time. Each request element also holds state information associated with the request. This includes a summary of the progress that has been made in processing the request, and a list of remaining work to be done.

Special processing instructions may also be associated with a request in the request queue. For example, in a wireless environment, it is usually too expensive to download graphics embedded in a page. If graphics have been suppressed for this request, this processing control information will be included in the request element. The request queue persists across client sessions.

Internally, a request consists of a set of attributes. Each attribute is a name-value pair. When the request is created, it is given attributes that contain the browser request. As processing proceeds, attributes are added describing the progress, any status information returned from the browser, and so on. Some attributes, such as the progress indication, are per request. Attributes may also be per queue, and in this case control processing for all elements added to the queue. Per-queue attributes are used to support multiple queues that handle requests in different ways, based on their source or the characterisits of the request. Thus, according to the present invention, more than one request queue may be created and requests may be automatically sorted into the appropriate queue when they are received by the client side intercept or they may be manually sorted by user input.

Because the present invention allows for off-line processing using applications such as a browser which were designed for synchronous on-line processing, disconnected and asynchronous operations require new user interfaces. Thus, according to the present invention, if a user's request can be satisfied from the cache, the response is provided immediately and the standard browser interface remains unchanged. On a cache miss, however, the browser's semantics may be extended with mechanisms and interfaces associated with the off-line processing of the present invention.

Because the browser is an immutable piece of code with respect to the present invention, a stand-in page may be returned whenever the remote/mobile data processing system is operating a synchronously or disconnected from the second computer and cannot satisfy a user's request from the cache. This page contains an explanation of what has happened—"Your request has been queued for later processing"— and, if requested, displays the current status of all pending requests. Note that as far as the browser is concerned, this stand-in page is the response to the request. In other words, the browser retains the request/response mechanism, while the intercept module utilizing the present invention handles the details of responding to the request. Furthermore, the same mechanism may be utilized for both disconnected and asynchronous requests in that an informational page is returned to the browser as the response to the request.

Alternatively, an option to return to the current page rather than being presented with an intermediate acknowledgment may be utilized. This option may be implemented by returning code **204** to the browser. From the user's point of view, a link is clicked but the browser remains on the same page, however, the intercept module according to the present invention queues the request in the background.

The present invention will now be described with respect to FIGS. **4** through **6** which are flowchart illustrations of one embodiment of the present invention. It will be understood that each block of the flowchart illustrations, and combinations of blocks in the flowchart illustrations, can be implemented by computer program instructions. These program instructions may be provided to a processor to produce a machine, such that the instructions which execute on the processor create means for implementing the functions specified in the flowchart block or blocks. The computer program instructions may be executed by a processor to cause a series of operational steps to be performed by the

processor to produce a computer implemented process such that the instructions which execute on the processor provide steps for implementing the functions specified in the flowchart block or blocks.

Accordingly, blocks of the flowchart illustrations support combinations of means for performing the specified functions, combinations of steps for performing the specified functions and program instruction means for performing the specified functions. It will also be understood that each block of the flowchart illustrations, and combinations of blocks in the flowchart illustrations, can be implemented by special purpose hardware-based systems which perform the specified functions or steps, or combinations of special purpose hardware and computer instructions.

FIG. **4** illustrates the operation of a client side intercept utilizing the present invention. As seen in FIG. **4**, the client side intercept **30** intercepts a request from browser **10** (block **50**). The client side intercept then determines if the response to the request is in the cache (block **52**) and if it is the cached response is returned to the web browser (block **54**).

If the response is not cached, then the client side intercept determines if the data processing system is connected to the second computer for access to the server (block **56**). If the data processing system is connected then, if requests are not deferred (block **58**), the request is sent to the second computer (block **60**). However, if the data processing system is either not connected or request processing is deferred, the the request is stored in a request queue and an interim response is provided to the browser as the response to the request (block **62**).

Processing of queued requests is handled by threads that run independently of any other activity in the client side intercept. Requests on the queue are usually handled on a first-in, first-out (FIFO) basis. However, selected requests may be marked as held, all new requests should be held (see block **58**). This allows the user to indicate that processing on these requests should be deferred until a later time, even if a connection is available. For example, some requests may be too expensive to handle on a wireless link, and so the user would prefer to defer processing them until a LAN or dialup connection is available. The hold attribute is also applied to any outstanding queued requests remaining when the client is first started. This avoids surprises when switching from an inexpensive link to a potentially much more expensive wireless link.

As is seen in FIG. **4**, the first step in handling a queued request is acquiring a connection to the second computer with access to the server of the request (block **64**). An attempt is made to get a connection when a request is first received and, if a connection is not established (block **66**), attempts will continue until a connection is made, either by the queue processor or due to other activity (block **70** and block **64**). An exponential backoff procedure is used to control the delay between connection attempts (block **68**). Thus, the time between attempts to connect increase as the number of attempts increases. This backoff procedure provides responsiveness when communication failures are transient without burdening the network when the failures are long term.

Once a connection is established, the information originally saved from the browser and stored in the request queue is used to reconstitute the request and the request is sent to the second computer (block **72**). At this point the request appears to a server as if it came directly from the browser. If the request fails due to failures in the wireless link (block **74**), subsequent attempts are made at later times. Retrying requests transparently masks transient communications failures. Other types of failures may also be recorded for later return to the user.

FIG. **5** illustrates the operations of the client side intercept module when a response is received to a previously queued request. As seen in FIG. **5**, a response is received from the server (block **80**). However, the use of graphics, applets, and other embeds is now nearly universal on Web pages. If the user has asked to see this information, the returned page is parsed for embeds (block **82**). Each embed is then retrieved (block **84**) and added to the cache along with the original response (block **86**). The response is associated with the request and any status information returned with the response is associated with the request (block **88**). At this point the request is complete and the user can be notified that it is available (block **90**).

Because the present invention provides a transparent HTTP proxy that will work with any browser. Queuing requests for background processing doesn't match the model that browsers expect, thus, an interim response, via HTML or an HTTP code, is returned to the browser so that the browser and the user can continue (see block **62** of FIG. **4**). Similarly, HTML pages and embedded HTML information may be used to report status to maintain browser independence.

Status of an outstanding request can be reported in any number of ways, including: an optional completion popup, an optional status bar embedded in the top of returned Web pages, or on an HTML page that summarizes the state of the queue.

The popup let users know that there is a newly completed page to view on the background page, and lists the URL of the page. One of these popups is generated the first time new information becomes available, and then further messages are suppressed until the user has visited the page and viewed the information. This allows the user to get an asynchronous completion notification without being overwhelmed on faster links.

The user may also chose to embed a status bar describing the state of the client side intercept in each returned page. This status bar includes information on the number of requests that have been completed, the number outstanding, and the number held. It also includes a textual version of the popup stating that new results are available, and links to various generated status pages.

One of these links may take the user to a page summarizing the state of the request. The page displays the queue, one line per request. Each request includes a graphical representation of the progress that has been made processing the request, using a visual indicator such as the model of a traffic light, where:

Red: Request has not been sent

Yellow: Base page received and embed(s) pending

Green: Request complete

Graphics may also have a distinctive look apart from its color such as red being an open circle, yellow a half-moon, and green a solid ball. In case of error (e.g., the request was sent but the base page could not be retrieved), an X may be placed across the traffic light symbol to indicate failure.

Along with the status graphics, options to delete or hold a request may also be displayed. In the case of forms, the user may also view or re-edit the request. If the request has completed, a link to the cached result may also be included on this page.

In order to provide URL-based access to the background queue and other internally-generated pages, the domain

name of the client side intercept may be used (e.g. artour.web.express) coupled with other options as appropriate. For example, the background queue may be accessed accessed via the URL http://artour.web.express/HTEP/. HTTP and a reserved domain name are preferred rather than defining a proprietary protocol name for such requests because standard browsers may reject unfamiliar protocols.

Progress of request handling may also be reported to a user. Requests move through a series of states as they are processed, starting with submitted, to processing begun, to initial page retrieved, and finally to completed. As a request moves into a state, an event describing the transition may be sent to an internal event manager. The internal event manager receives status of requests and forwards status information to other components or applications. Other components may register with the event manager to receive events, filtered by event state and other criteria. Processing events can be used to generate dynamic interfaces the client side intercept. The popup notification is one example of the use of these events.

After a response is received, the response also needs to be saved for future off-line viewing for the user. However, when a browser makes a request and receives a response, it typically handles it in one of two ways. If the response is expected to be relatively static, it is cached by the browser so that future requests to the page can be handled quickly. However, if the page is a response to a forms request, or is otherwise generated (so-called "cgi-bin" requests), the browser only displays the response, and doesn't cache it, since the response is typically different from one cgi-bin request to the next. Also, with objects that the source server marks "no-cache," browsers and proxies, that observe this directive do not save these items. However, when one is retrieved as part of processing a queued request, it must be saved for later viewing.

These, normally transient objects are saved (block **86**) as a new category of cached information: user data. These are data that have been retrieved in response to a user request, and only have meaning in the context of that request. Unlike normal web data, user data objects are only accessible as responses on the queue status page. They are not used to handle other requests, since they are transient time- or request-sensitive responses. User data are not subject to the normal coherency and aging algorithms used to manage the cache. They persist and are valid until deleted by the user.

Web page designers often employ HTML forms for data entry that requires only simple interaction. HTML form tags provide a convenient way for building electronic forms for Web interaction. HTML form tags allow a Web user to make selections from a list, to check on/off boxes, to select from radio buttons, to enter text into a text field or a large multi-line text area, and to push action buttons. When the user presses an action button, the entered data is sent to a Web server designated by the action with name/value pairs, where each name represents an input field and each value represents the user's input in the field. In addition, there may be hidden fields, which carry preset values that a Web server sent along with the form. These hidden values are sent back to the server together with the values in visible fields.

Like any HTML page, an HTML form can be cached for future use. According to the present invention, a cached HTML form may be edited for submission later or resubmission again with different user input. For example, a search input form could be edited again and again to send out different search requests. Similarly, an intranet data entry form such as a patient admission form could be edited to correct data entry errors, or resubmitted with new data for a different patient. Most forms can be meaningfully cached for independent future submission because they either have a simple one-form interaction model or contain self-sufficient hidden fields so that the Web application can accept a submission in isolation.

In a mobile environment, disconnected form submission can extend the productivity of users even when a server is not reachable. This allows multiple data entry pages to be filled without connecting to any network. Also, with the re-editing function of the present invention, a user can draft a few forms and have a chance to review, approve, or edit them before they finally are sent to the server.

As described above, a form may be treated as any HTML page and the operations of FIG. **4** carried out to create an entry in the request queue corresponding to the filled out form. Like regular HTML pages, the user obtains a cached HTML form using a URL. The user fills in the form and submits it using one of the action buttons. When a form is submitted, the name/value pairs together with the originating form URL are stored and queued. If the user requests the same URL form again and submits a new result, the new submission is kept separate from the previous submission. Every submission is counted as a separate entry in the queue for automatic submission when a connection becomes available. These entries remains stored until they are deleted by a user.

FIG. **6** illustrates the re-editing process of forms utilizing the present invention. This reediting utilizes the forms in the queue of FIG. **4**. As seen in FIG. **6**, a list of available forms in the queue is provided to the browser (block **100**) and user input selecting a queue entry is obtained (block **102**). An HTML page may be presented to the user to display the entries in the queue which may be accessed using hyperlinks.

Based on the user input a form corresponding to the URL of the form used to generate the queued request is obtained from the local cache (block **104**). The base form may be retrieved based on previously inserted data indicating the origin of the form. When the blank form is first fetched from the server, the client side intercept inserts hidden values into the HTML before returning the page to the browser. The hidden information includes both the originating URL and the form number within the page. To re-edit the form, the blank form is retrieved using the hidden value containing the form's URL which is stored with the request in the request queue to associate the request with the form that generated the request.

The form and the queued request are scanned to match name/value pairs in the request (block **106**). If any match is found, the default selection or input value is then changed to reflect the user's submission (block **108**). Special care should be taken with Web pages that consist of multiple HTML forms, since they may use the same field names in different subforms. Therefore, according to the present invention, subforms are assigned a unique identifier and tracked so that the proper form may be recalled to recreate the original request. The original input form and data are then reconstructed. If a response to request has already been received, (block **110**) then, optionally, the submission button may be replaced by a link to the response so that the user may view the results of the submission (block **112**). Otherwise, the reconstructed request is provided to the browser for editing by the user (block **114**). If resubmitted the existing queue entry may be overwritten with the new data, or, optionally, the user could select that a new entry in the queue is provided. Such a feature would allow the user to use a filled out form as a template for creating additional requests with similar data with only minor further input.

In the drawings and specification, there have been disclosed typical preferred embodiments of the invention and, although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention being set forth in the following claims.

That which is claimed is:

1. A method for communicating with a web browser executing on a remote/mobile processing system which is temporarily and intermittently connected to a second computer, said method comprising the steps of:

storing in a persistent request queue at the remote/mobile processing system, a request from the web browser to a server application accessible to the second computer;

providing an interim response to the web browser in response to the request from the web browser; and

recalling the stored request to allow user modification of the stored request prior to the request being provided to the second computer for transmission to the server application.

2. A method according to claim 1 further comprising the steps of:

transmitting the stored request to the second computer when the remote/mobile data processing system is connected to the second computer;

receiving, through the second computer, a response to the request from the server;

storing the response to the request at the remote/mobile processing system; and

associating the stored response with the stored request.

3. A method according to claim 2, further comprising the step of providing the stored response to the web browser.

4. A method according to claim 2, further comprising the steps of:

providing a list of stored requests to the web browser for presentation to a user;

accepting user input to select one of the stored requests in the list of stored requests; and

providing to the web browser, the associated response to a selected one of the list of stored requests based upon user input.

5. A method according to claim 2, further comprising the steps of:

notifying the user of the availability of the received response when the response is received by the remote/mobile data processing system; and

providing the response to the web browser if the user requests the response.

6. A method according to claim 1, wherein said step of storing a request from the web browser comprises the steps of:

storing an HTML form associated with the request;

storing user input associated with the request; and

associating the stored user input with the stored HTML form.

7. A method according to claim 6, further comprising the steps of:

providing a list of stored requests to the web browser for presentation to a user;

accepting user input to select one of the stored requests in the list of stored requests; and

wherein said recalling step recalls the stored request selected by the user input.

8. A method according to claim 7, wherein said step of recalling the stored request comprises the steps of:

recalling the stored form associated with the request;

recalling the stored user input associated with the request; and

providing the recalled form and the recalled user input to the web browser so as to recreate the form with the user input.

9. A method according to claim 8, wherein said step of providing the recalled form and the recalled user input comprises the steps of:

scanning the recalled form for named fields in the recalled form;

scanning the recalled user input for name/value pairs in the user input; and

replacing the default selection or user input of the named field in the recalled form with the value of a matching name/value pair from the user input.

10. A method according to claim 8, further comprising the steps of:

determining if a response to the recalled stored request has been stored at the remote/mobile data processing system; and

adding a link to the stored response to the recalled form so as to provide to the user a hyperlink to recall the stored response.

11. A method according to claim 8, further comprising the steps of:

accepting user input to revise an original request from the web browser so as to provide a revised request based upon the original request modified by the user input; and

storing the revised request in the request queue.

12. A method according to claim 11, wherein said step of storing the revised request comprises the step of replacing the request in the request queue with the revised request.

13. A method according to claim 1, further comprising the steps of:

determining if said remote/mobile data processing system is linked to the second computer; and

wherein said storing and said providing steps are carried out if said determining step determines that the remote/mobile data processing system is not linked to the second computer.

14. A system for communicating with a web browser executing on a remote/mobile processing system which is temporarily and intermittently connected to a second computer, comprising:

means for storing in a persistent request queue at the remote/mobile processing system, a request from the web browser to a server application accessible to the second computer;

means for providing an interim response to the web browser in response to the request from the web browser; and

means for recalling the stored request to allow user modification of the stored request prior to the request being provided to the second computer for transmission to the server application.

15. A system according to claim 14 further comprising:

means for transmitting the stored request to the second computer when the remote/mobile data processing system is connected to the second computer;

means for receiving, through the second computer, a response to the request from the server;

means for storing the response to the request at the remote/mobile processing system; and

means for associating the stored response with the stored request.

16. A system according to claim 15, further comprising means for providing the stored response to the web browser.

17. A system according to claim 15, further comprising:

means for providing a list of stored requests to the web browser for presentation to a user;

means for accepting user input to select one of the stored requests in the list of stored requests; and

means for providing to the web browser, the associated response to a selected one of the list of stored requests based upon user input.

18. A system according to claim 15, further comprising:

means for notifying the user of the availability of the received response when the response is received by the remote/mobile data processing system; and

means for providing the response to the web browser if the user requests the response.

19. A system according to claim 14, wherein said means for storing a request from the web browser comprises:

means for storing an HTML form associated with the request;

means for storing user input associated with the request; and

means for associating the stored user input with the stored HTML form.

20. A system according to claim 19, further comprising:

means for providing a list of stored requests to the web browser for presentation to a user;

means for accepting user input to select one of the stored requests in the list of stored requests; and

wherein said means for recalling recalls the stored request selected by the user input.

21. A system according to claim 20, wherein said means for recalling the stored request comprises:

means for recalling the stored form associated with the request;

means for recalling the stored user input associated with the request; and

means for providing the recalled form and the recalled user input to the web browser so as to recreate the form with the user input.

22. A system according to claim 21, wherein said means for providing the recalled form and the recalled user input comprises:

means for scanning the recalled form for named fields in the recalled form;

means for scanning the recalled user input for name/value pairs in the user input; and

means for replacing the default selection or user input of the named field in the recalled form with the value of a matching name/value pair from the user input.

23. A system according to claim 21, further comprising:

means for determining if a response to the recalled stored request has been stored at the remote/mobile data processing system; and

means for adding a link to the stored response to the recalled form so as to provide to the user a hyperlink to recall the stored response.

24. A system according to claim 21, further comprising:

means for accepting user input to revise an original request from the web browser so as to provide a revised request based upon the original request modified by the user input; and

means for storing the revised request in the request queue.

25. A system according to claim 24, wherein said means for storing the revised request comprises means for replacing the request in the request queue with the revised request.

26. A system according to claim 14, further comprising:

means for determining if said remote/mobile data processing system is linked to the second computer; and

wherein said means for storing and said means for providing are store and provide requests if said means for determining determines that the remote/mobile data processing system is not linked to the second computer.

27. A computer program product for communicating with a web browser executing on a remote/mobile processing system which is temporarily and intermittently connected to a second computer, the computer program product comprising:

a computer-readable storage medium having computer-readable program code means embodied in said medium, said computer-readable program code means a comprising:

computer-readable program code means for storing in a persistent request queue at the remote/mobile processing system, a request from the web browser to a server application accessible to the second computer;

computer-readable program code means for providing an interim response to the web browser in response to the request from the web browser; and

computer-readable program code means for recalling the stored request to allow user modification of the stored request prior to the request being provided to the second computer for transmission to the server application.

28. A computer program product according to claim 27 further comprising:

computer-readable program code means for transmitting the stored request to the second computer when the remote/mobile data processing system is connected to the second computer;

computer-readable program code means for receiving, through the second computer, a response to the request from the server;

computer-readable program code means for storing the response to the request at the remote/mobile processing system; and

computer-readable program code means for associating the stored response with the stored request.

29. A computer program product according to claim 28, further comprising computer-readable program code means for providing the stored response to the client application.

30. A computer program product according to claim 28, further comprising:

computer-readable program code means for providing a list of stored requests to the web browser for presentation to a user;

computer-readable program code means for accepting user input to select one of the stored requests in the list of stored requests; and

computer-readable program code means for providing to the web browser, the associated response to a selected one of the list of stored requests based upon user input.

31. A computer program product according to claim 28, further comprising:

computer-readable program code means for notifying the user of the availability of the received response when the response is received by the remote/mobile data processing system; and

computer-readable program code means for providing the response to the web browser if the user requests the response.

32. A computer program product according to claim **27**, wherein said computer-readable program code means for storing a request from the web browser comprises:

computer-readable program code means for storing an HTML form associated with the request;

computer-readable program code means for storing user input associated with the request; and

computer-readable program code means for associating the stored user input with the stored HTML form.

33. A computer program product according to claim **32**, further comprising:

computer-readable program code means for providing a list of stored requests to the web browser for presentation to a user;

computer-readable program code means for accepting user input to select one of the stored requests in the list of stored requests; and

wherein said computer-readable program code means for recalling recalls the stored request selected by the user input.

34. A computer program product according to claim **33**, wherein said computer-readable program code means for recalling the stored request comprises:

computer-readable program code means for recalling the stored form associated with the request;

computer-readable program code means for recalling the stored user input associated with the request; and

computer-readable program code means for providing the recalled form and the recalled user input to the web browser so as to recreate the form with the user input.

35. A computer program product according to claim **34**, wherein said computer-readable program code means for providing the recalled form and the recalled user input comprises:

computer-readable program code means for scanning the recalled form for named fields in the recalled form;

computer-readable program code means for scanning the recalled user input for name/value pairs in the user input; and

computer-readable program code means for replacing the default selection or user input of the named field in the recalled form with the value of a matching name/value pair from the user input.

36. A computer program product according to claim **34**, further comprising:

computer-readable program code means for determining if a response to the recalled stored request has been stored at the remote/mobile data processing system; and

computer-readable program code means for adding a link to the stored response to the recalled form so as to provide to the user a hyperlink to recall the stored response.

37. A computer program product according to claim **34**, further comprising:

computer-readable program code means for accepting user input to revise an original request from the web browser so as to provide a revised request based upon the original request modified by the user input; and

computer-readable program code means for storing the revised request in the request queue.

38. A computer program product according to claim **37**, wherein said computer-readable program code means for storing the revised request comprises computer-readable program code means for replacing the request in the request queue with the revised request.

39. A computer program product according to claim **27**, further comprising:

computer-readable program code means for determining if said remote/mobile data processing system is linked to the second computer; and

wherein said computer-readable program code means for storing and said computer-readable program code means for providing are store and provide requests if said computer-readable program code means for determining determines that the remote/mobile data processing system is not linked to the second computer.

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[54] **TRANSMITTING HIGH BANDWIDTH NETWORK CONTENT ON A LOW BANDWIDTH COMMUNICATIONS CHANNEL DURING OFF PEAK HOURS**

[75] Inventors: **Stephen G. Perlman**, Mountain View; **William H. Yundt**, Foster City; **Stuart Schneck**, Piedmont, all of Calif.

[73] Assignee: **WebTV Networks, Inc.**, Mountain View, Calif.

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"A Hierarchical Internet Object Cache", Chankhunthod, et al., U.C. Southern California & U.C. Colorado, 6pp.

"Monitoring Corporate Information With FirstFloor Products", FirstFloor, pp. 1–9, 1996.

Primary Examiner—Douglas W. Olms

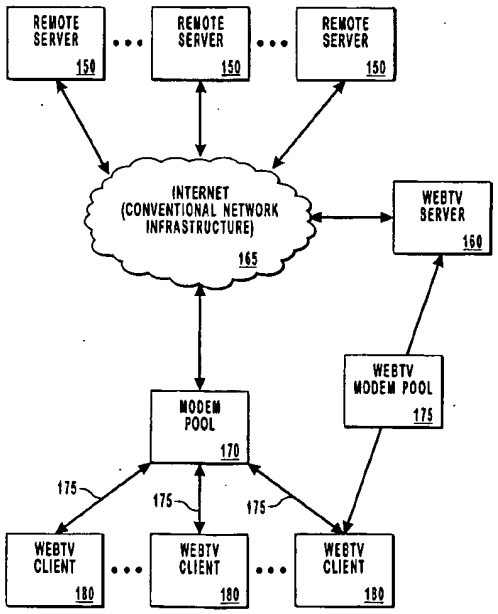
Assistant Examiner—Phirin Sam

Attorney, Agent, or Firm—Workman, Nydegger, Seeley

[57] **ABSTRACT**

The present invention describes a method for transmitting high bandwidth network content on a low bandwidth communications channel during off peak hours. According to one embodiment of the present invention, criteria is determined for downloading data from the communications channel and the data is downloaded from the communications channel during off-peak hours based on the determined criteria. According to another embodiment, a method for coordinated multicasts on a network is described. Download requests are received on a server from a plurality of clients on the network and stored on the server for the coordinated multicast. The coordinated multicast is generated at a predetermined time and then broadcast from the server to the plurality of clients at the predetermined time.

20 Claims, 10 Drawing Sheets



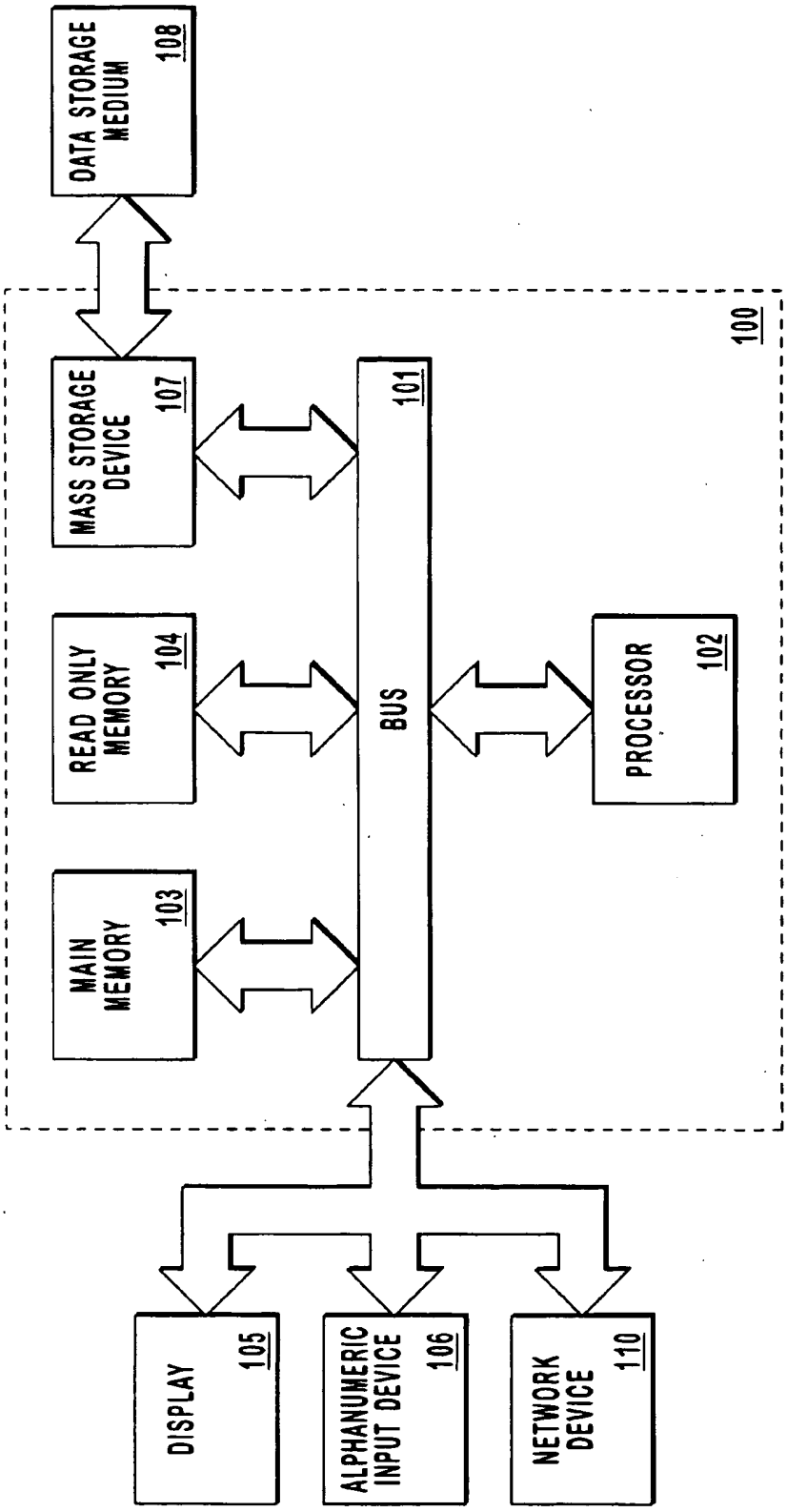

DATA STORAGE MEDIUM
108
100
MASS STORAGE DEVICE
107
101
READ ONLY MEMORY
104
BUS
PROCESSOR
102
MAIN MEMORY
103
DISPLAY
105
ALPHANUMERIC INPUT DEVICE
106
NETWORK DEVICE
110

FIG. 1A

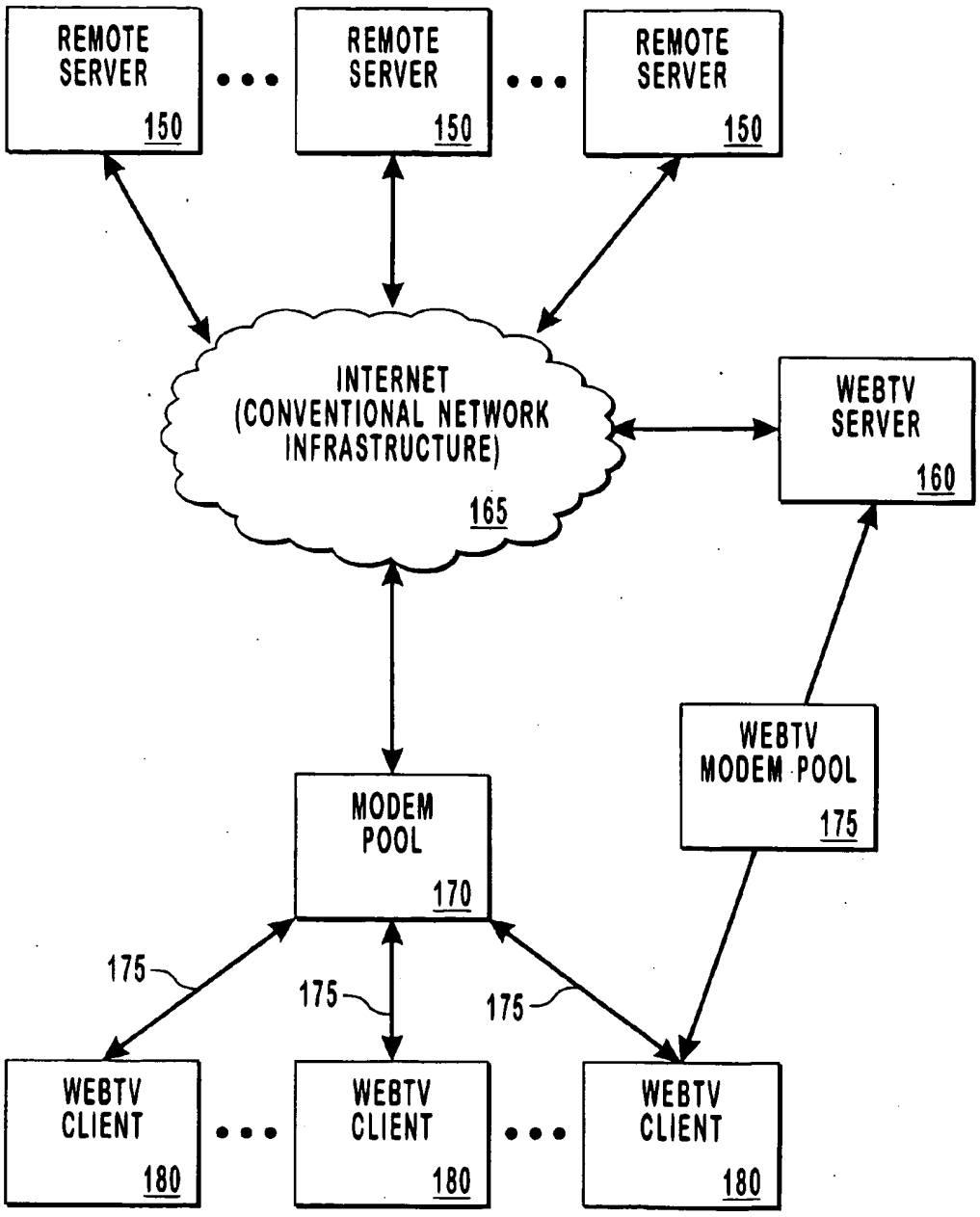

REMOTE SERVER 150
REMOTE SERVER 150
REMOTE SERVER 150
INTERNET (CONVENTIONAL NETWORK INFRASTRUCTURE) 165
WEBTV SERVER 160
WEBTV MODEM POOL 175
MODEM POOL 170
175
175
175
WEBTV CLIENT 180
WEBTV CLIENT 180
WEBTV CLIENT 180

FIG. 1B

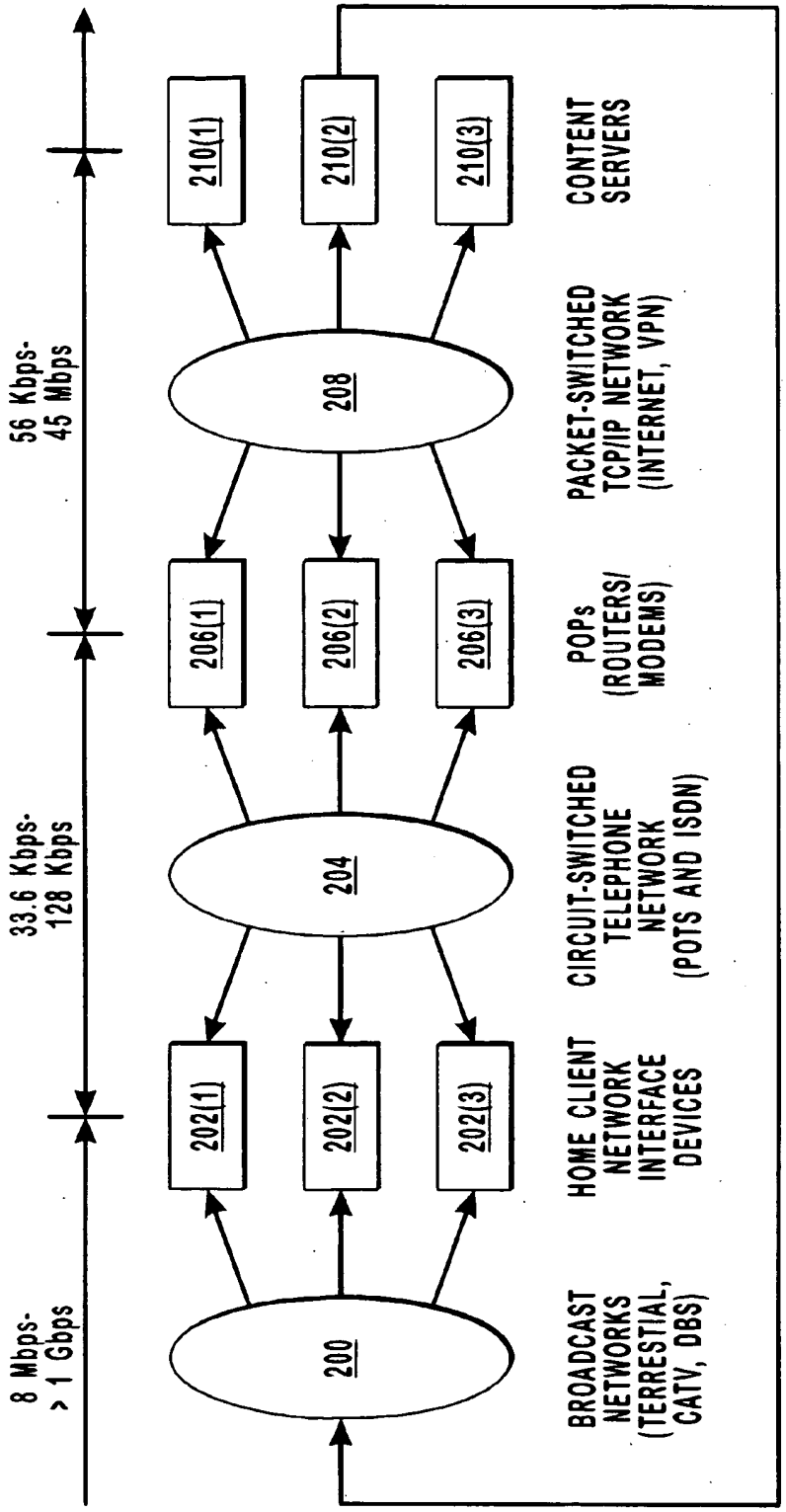

8 Mbps-
> 1 Gbps
33.6 Kbps-
128 Kbps
56 Kbps-
45 Mbps
200
202(1)
202(2)
202(3)
204
206(1)
206(2)
206(3)
208
210(1)
210(2)
210(3)
BROADCAST NETWORKS (TERRESTIAL, CATV, DBS)
HOME CLIENT NETWORK INTERFACE DEVICES
CIRCUIT-SWITCHED TELEPHONE NETWORK (POTS AND ISDN)
POPs (ROUTERS/ MODEMS)
PACKET-SWITCHED TCP/IP NETWORK (INTERNET, VPN)
CONTENT SERVERS

FIG. 2A

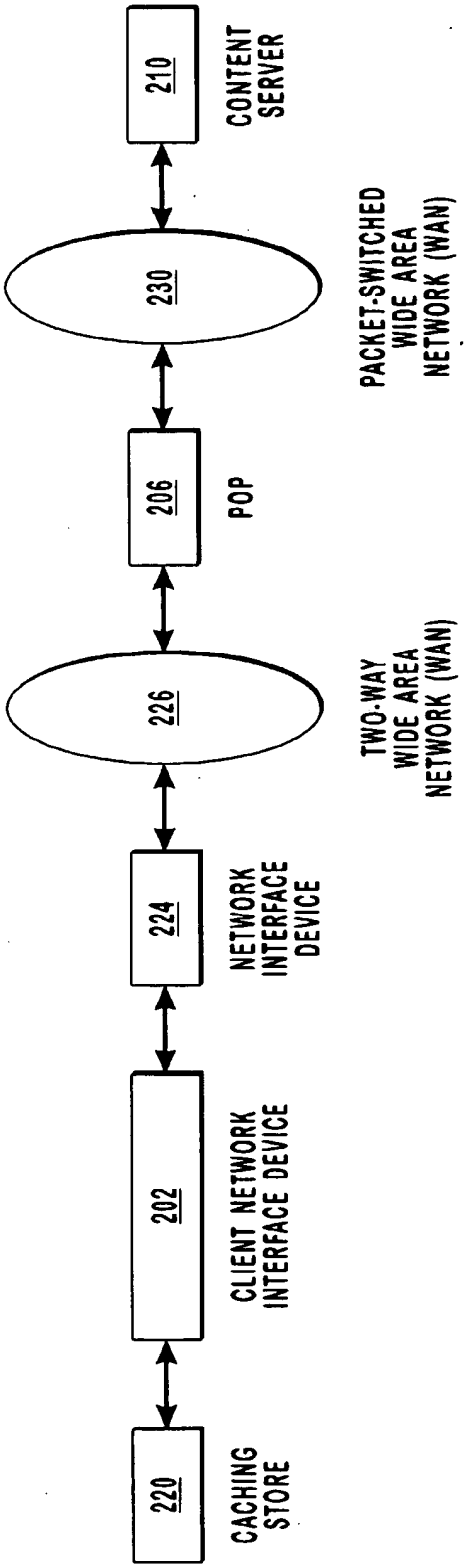

210
CONTENT SERVER
230
PACKET-SWITCHED WIDE AREA NETWORK (WAN)
206
POP
226
TWO-WAY WIDE AREA NETWORK (WAN)
224
NETWORK INTERFACE DEVICE
202
CLIENT NETWORK INTERFACE DEVICE
220
CACHING STORE

FIG. 2B

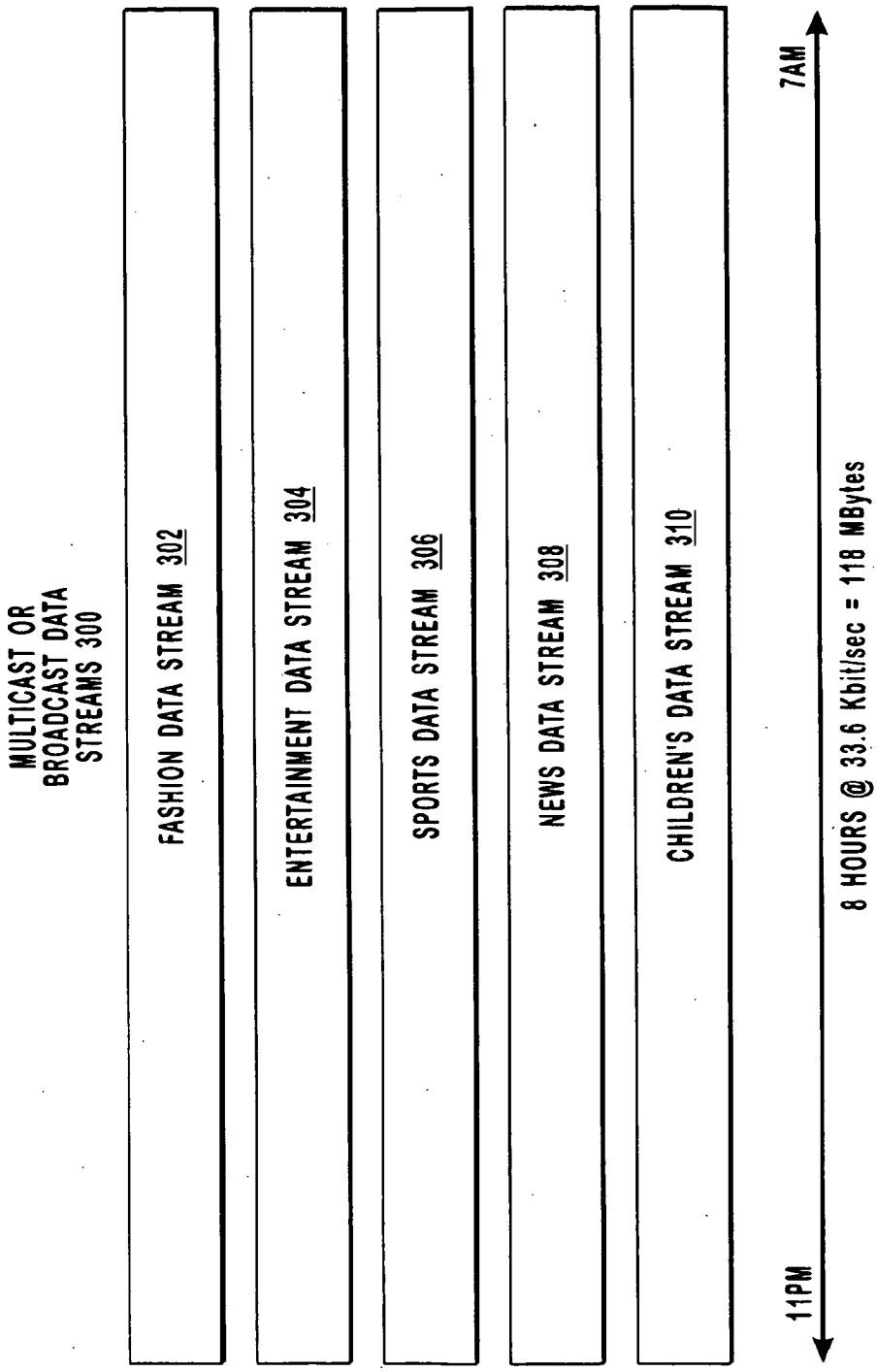

MULTICAST OR BROADCAST DATA STREAMS 300
FASHION DATA STREAM 302
ENTERTAINMENT DATA STREAM 304
SPORTS DATA STREAM 306
NEWS DATA STREAM 308
CHILDREN'S DATA STREAM 310
7AM
11PM
8 HOURS @ 33.6 Kbit/sec = 118 MBytes

FIG. 3A

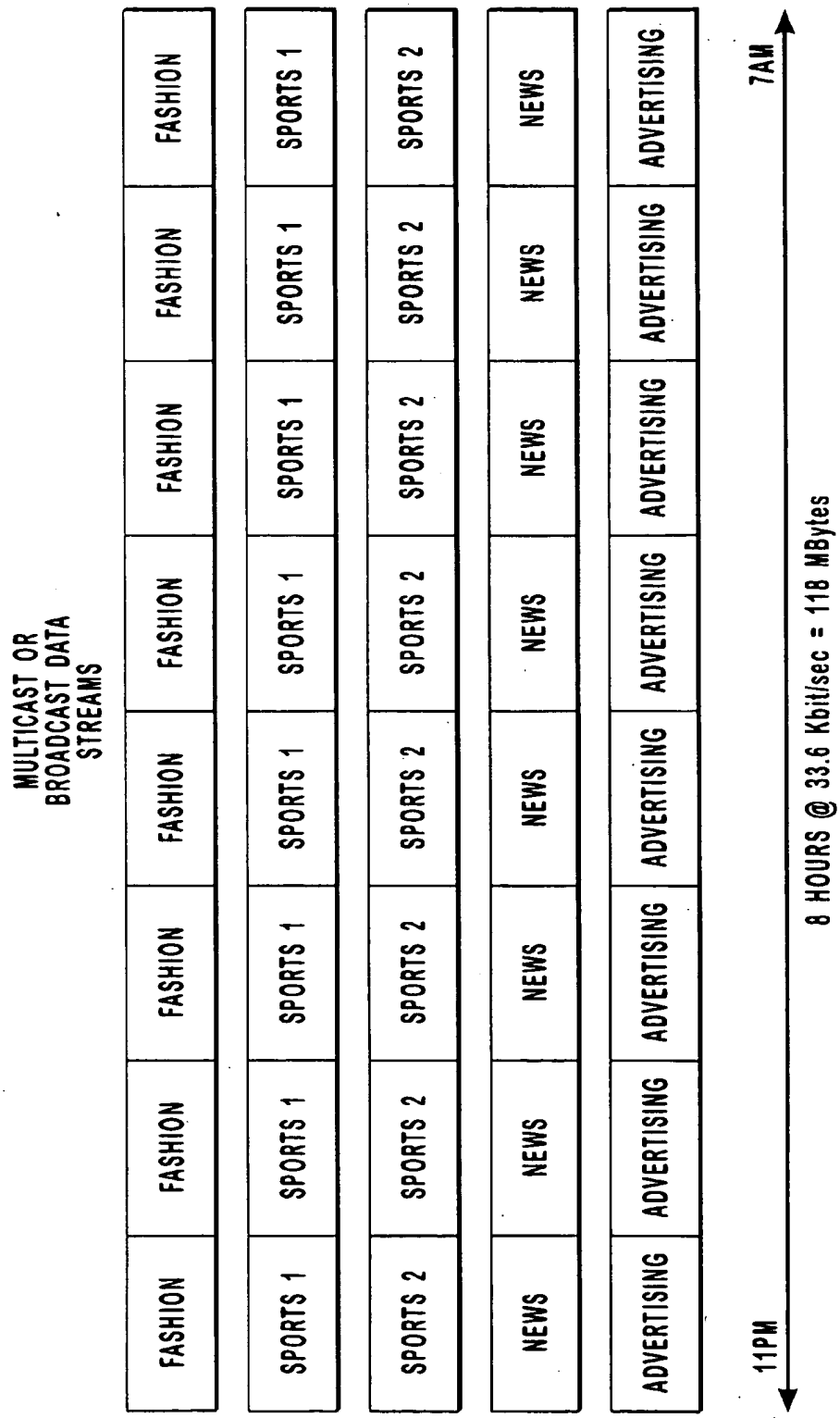

MULTICAST OR
BROADCAST DATA
STREAMS
FASHION
SPORTS 1
SPORTS 2
NEWS
ADVERTISING
11PM
7AM
8 HOURS @ 33.6 Kbit/sec = 118 MBytes

FIG. 3B

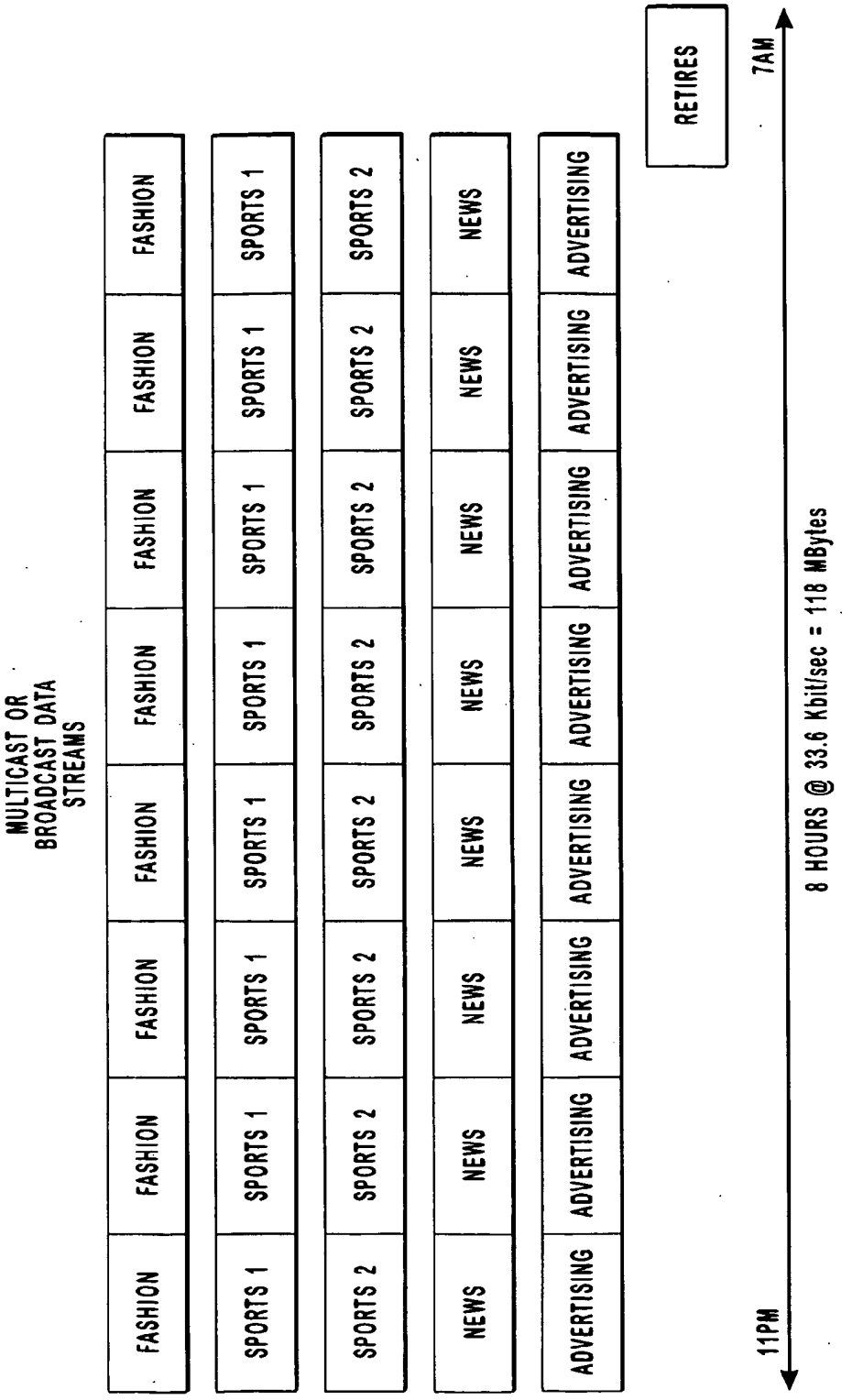

MULTICAST OR BROADCAST DATA STREAMS
FASHION
SPORTS 1
SPORTS 2
NEWS
ADVERTISING
RETIRES
7AM
11PM
8 HOURS @ 33.6 Kbit/sec = 118 MBytes

FIG. 3C

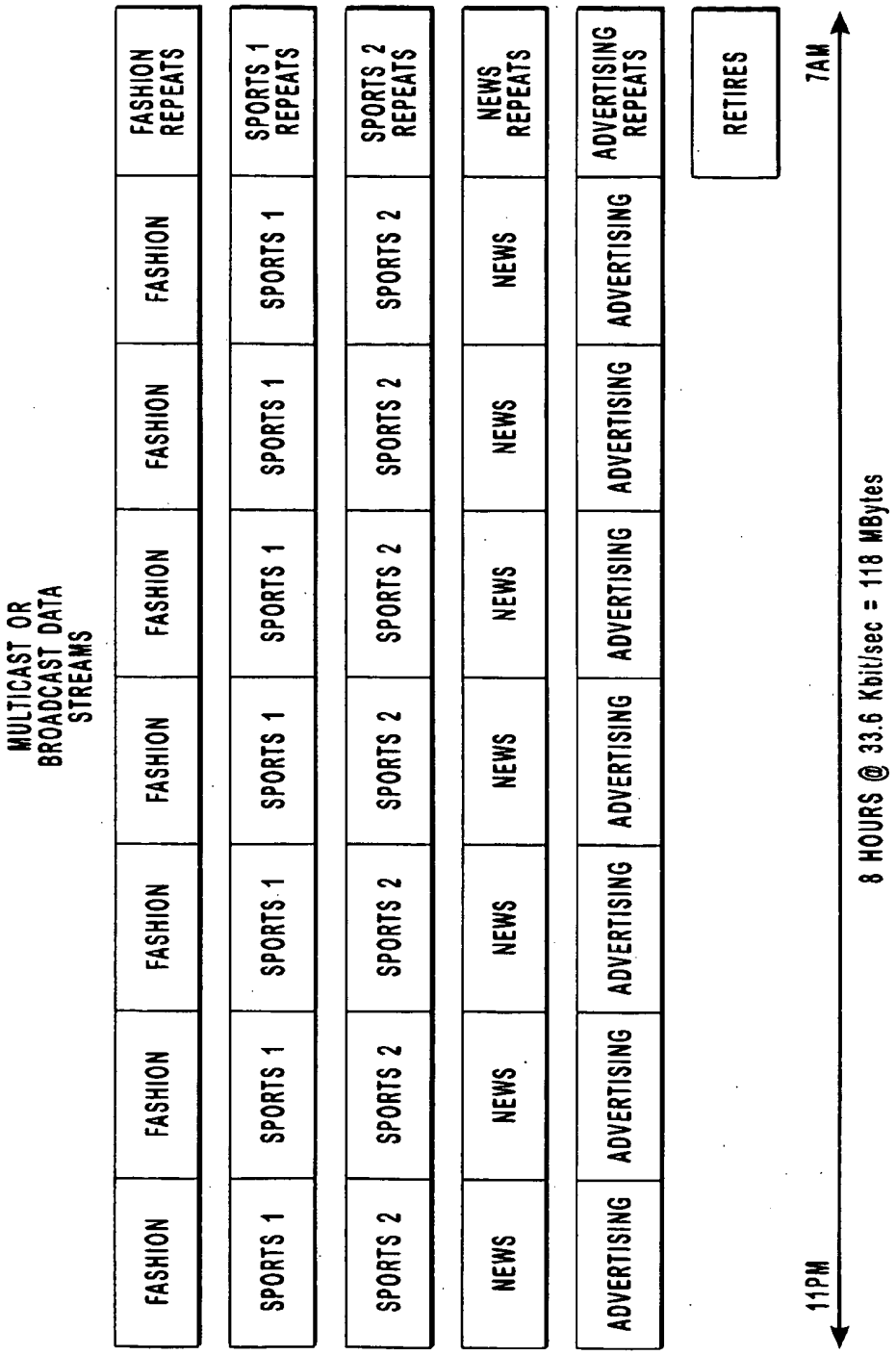

MULTICAST OR
BROADCAST DATA
STREAMS
FASHION
FASHION
FASHION
FASHION
FASHION
FASHION
FASHION REPEATS
SPORTS 1
SPORTS 1
SPORTS 1
SPORTS 1
SPORTS 1
SPORTS 1
SPORTS 1 REPEATS
SPORTS 2
SPORTS 2
SPORTS 2
SPORTS 2
SPORTS 2
SPORTS 2
SPORTS 2 REPEATS
NEWS
NEWS
NEWS
NEWS
NEWS
NEWS
NEWS REPEATS
ADVERTISING
ADVERTISING
ADVERTISING
ADVERTISING
ADVERTISING
ADVERTISING
ADVERTISING REPEATS
RETIRES
11PM
7AM
8 HOURS @ 33.6 Kbit/sec = 118 MBytes

FIG. 3D

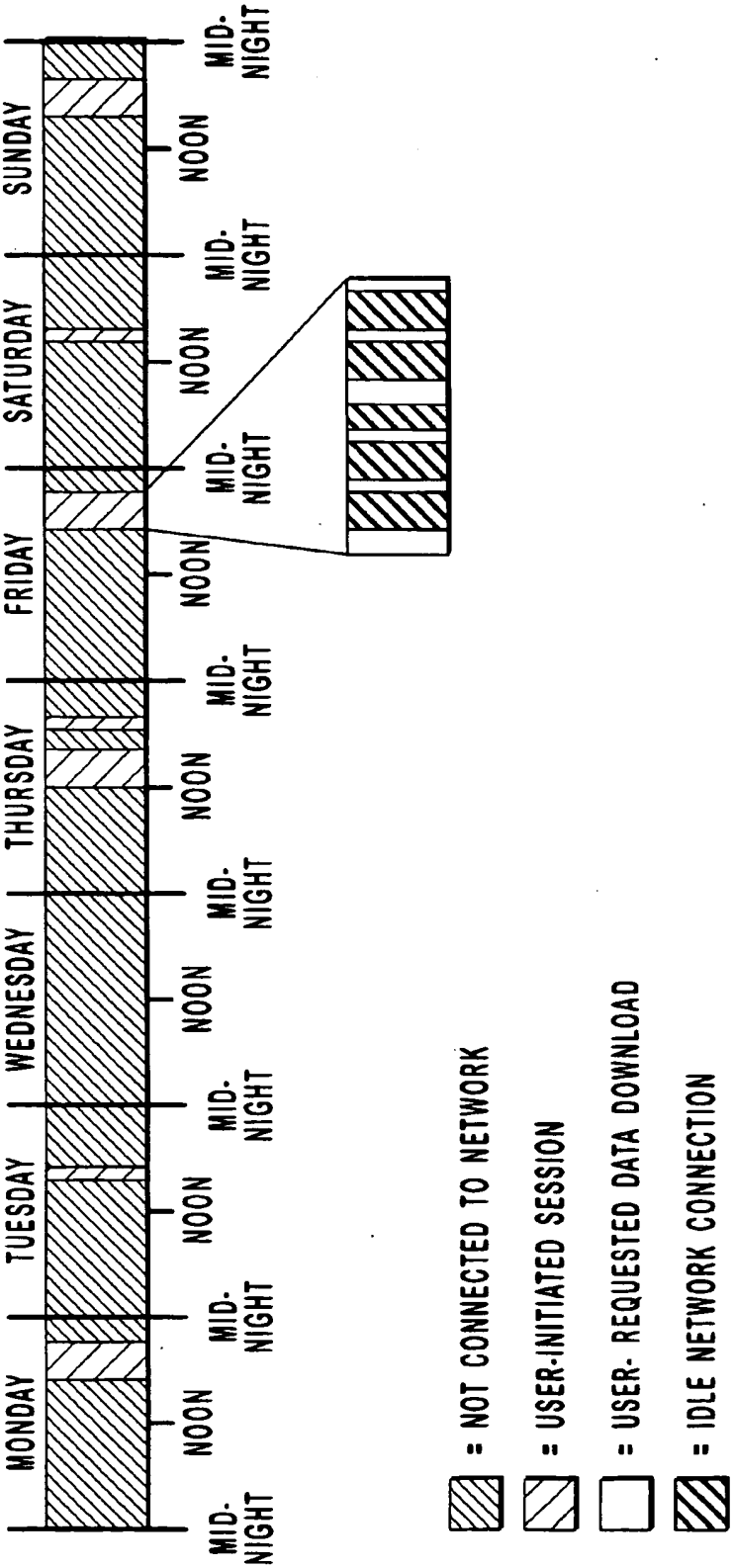


FIG. 4
(PRIOR ART)

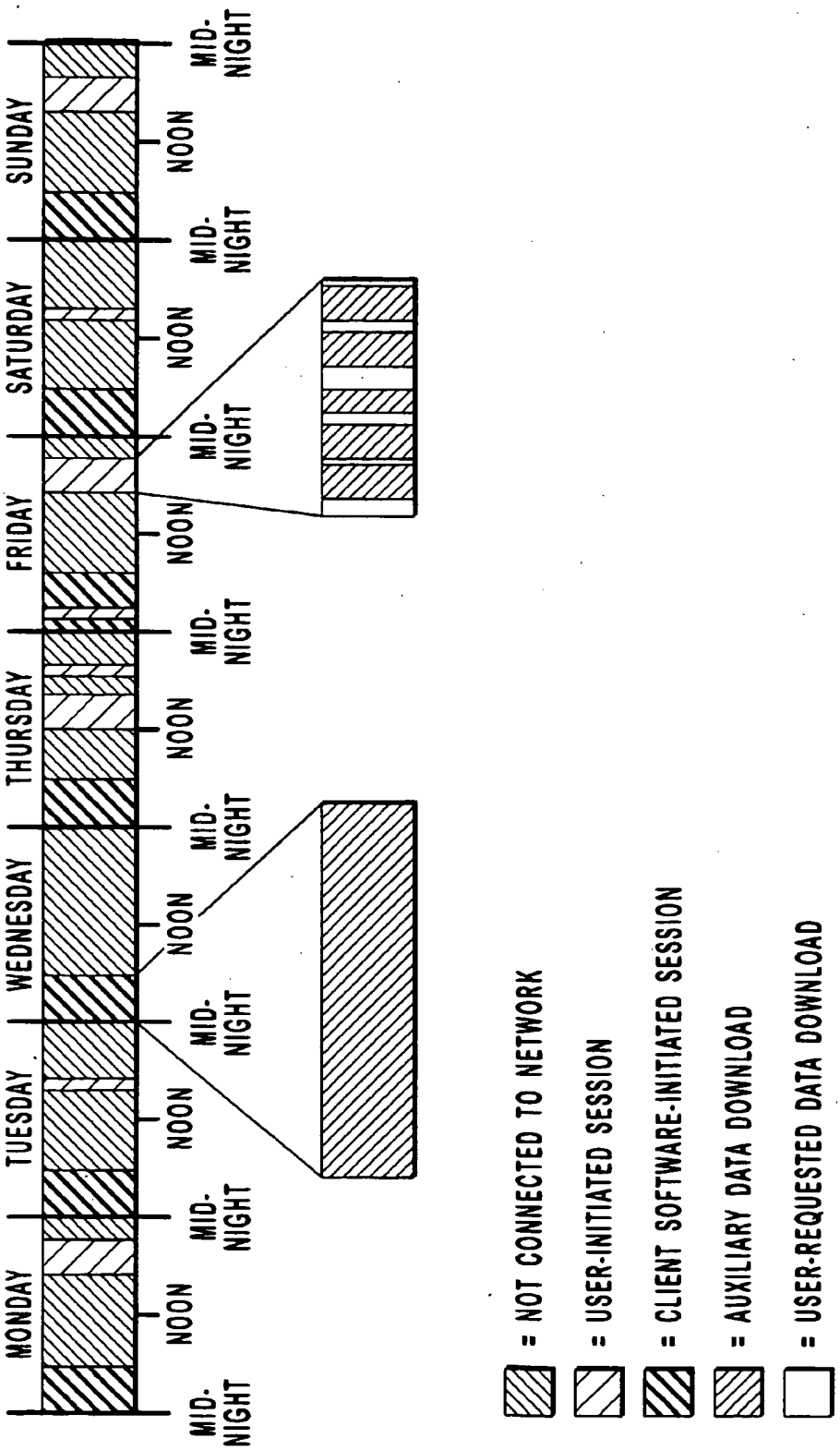

MONDAY
TUESDAY
WEDNESDAY
THURSDAY
FRIDAY
SATURDAY
SUNDAY
MID-NIGHT
NOON
= NOT CONNECTED TO NETWORK
= USER-INITIATED SESSION
= CLIENT SOFTWARE-INITIATED SESSION
= AUXILIARY DATA DOWNLOAD
= USER-REQUESTED DATA DOWNLOAD

FIG. 5

TRANSMITTING HIGH BANDWIDTH NETWORK CONTENT ON A LOW BANDWIDTH COMMUNICATIONS CHANNEL DURING OFF PEAK HOURS

FIELD OF THE INVENTION

The present invention relates to the field of networked computer systems. Specifically, the present invention relates to a method and apparatus for transmitting high bandwidth network content on a low bandwidth communications channel during off peak hours.

DESCRIPTION OF RELATED ART

With the advent of consumer-oriented services on global networks such as the Internet, there has been an explosion of interest in delivering these services to users in their homes. Private on-line services such as America On-line (AOL™), Internet Service Providers (ISPs) such as Netcom™, and television-based Internet services such as the WebTV™ Network from WebTV Networks, Inc., are all seeking to provide on-line services to typical consumers in their homes.

Unfortunately, the world's residential communication infrastructure was not designed to accommodate the high-bandwidth, two-way requirements of on-line services. Consequently, usage in the home is, for the most part, limited to "plain old telephone service" or "POTS" modems and Integrated Services Digital Network (ISDN) services. Although modems are becoming increasingly more efficient in utilizing the bandwidth of a telephone voice channel, they are ultimately limited to the 64 Kbps digitization of voice channels in the switched telephone network. ISDN, in some countries, can provide approximately 128 Kbps in bandwidth. That is, however, the upper limit in bandwidth for two-way communications using today's available infrastructure to homes.

Although there are other experimental and proposed technologies to provide two-way high-bandwidth communications to the home beyond 128 Kbps, none of these technologies have been deployed to any significant degree on a nationwide or worldwide basis. For example, Asynchronous Digital Subscriber Loop (ADSL) uses the telephone twisted pair going to the home from the telephone central office to provide over 1 Mbps of downstream (to the home) bandwidth and lower upstream bandwidth. Cable modems, utilizing the Cable TV (CATV) infrastructure can provide over 10 Mbits of downstream bandwidth and over 1 Mbps of upstream bandwidth. Also, hybrid approaches have been proposed in which a POTS telephone modem provides a low-bandwidth upstream channel while a one-way cable modem, a Direct Broadcast Satellite (DBS) feed, or even a terrestrial broadcast provides the downstream channel at over 10 Mbits/sec,

Each of these high-bandwidth technologies has significant infrastructure upgrade implications and/or significant scalability limitations. For example, ADSL requires the installation of ADSL modems in every telephone central office. Clearly, this amounts to a monumental undertaking. Cable, DBS, and terrestrial communications systems are broadcast architectures with limited overall bandwidth which is easily swamped when it is used for individual messages to potentially thousands, or even millions, of subscribers. Although a given cable plant can theoretically be segmented into independent subtrees to handle more individual messages, there are still monumental infrastructure upgrade implications.

Thus, given the bandwidth limitations of current communications infrastructure to the home, and given the high cost, monumental upgrade implications, and limitations of proposed new infrastructure, better methods are needed to bring high-bandwidth content services into the home using existing infrastructure.

SUMMARY OF THE INVENTION

The present invention describes a method for transmitting high bandwidth network content on a low bandwidth communications channel during off peak hours. According to one embodiment of the present invention, criteria is determined for downloading data from the communications channel and the data is downloaded from the communications channel during off-peak hours based on the determined criteria.

According to another embodiment, a method for coordinated multicasts on a network is described. Download requests are received on a server from a plurality of clients on the network and stored on the server for the coordinated multicast. The coordinated multicast is generated at a predetermined time and then broadcast from the server to the plurality of clients at the predetermined time.

Other objects, features and advantages of the present invention will be apparent from the accompanying drawings and from the detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is illustrated by way of example and not by way of limitation in the figures of the accompanying drawings in which like reference numerals refer to similar elements and in which:

FIG. **1A** is a typical computer system in which the present invention operates.

FIG. **1B** is an alternate computer system (a WebTV system) in which the present invention operates.

FIGS. **2A** and **2B** illustrate the currently available devices and services on the Internet today

FIGS. **3A–3D** illustrate multicast or broadcast data streams according to various embodiments of the present invention

FIG. **4** illustrates prior art utilization of idle time and off-peak time on a network

FIG. **5** illustrates improved utilization of idle time and off-peak time on a network according to one embodiment of the present invention

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention is a method and apparatus for transmitting high bandwidth network content on a two-way low bandwidth communications channel during off peak hours. One embodiment of the present invention utilizes typical on-line services and Internet usage patterns as well usage patterns of existing communications channels to provide the user of a low bandwidth communications channel with an experience similar to the experience enjoyed by users utilizing a high-bandwidth communication channel. In the following detailed description, numerous specific details are set forth in order to provide a thorough understanding of the present invention. It will be apparent to one of ordinary skill in the art that these specific details need not be used to practice the present invention. In other instances, well-known structures, interfaces, and processes have not been shown in detail in order not to unnecessarily obscure the present invention.

FIG. 1A illustrates a typical computer system **100** in which the present invention operates. One embodiment of the present invention is implemented on a personal computer architecture. It will be apparent to those of ordinary skill in the art that other alternative computer system architectures may also be employed.

In general, such computer systems as illustrated by FIG. 1A comprise a bus **101** for communicating information, a processor **102** coupled with the bus **101** for processing information, main memory **103** coupled with the bus **101** for storing information and instructions for the processor **102**, a read-only memory **104** coupled with the bus **101** for storing static information and instructions for the processor **102**, a display device **105** coupled with the bus **101** for displaying information for a computer user, an input device **106** coupled with the bus **101** for communicating information and command selections to the processor **102**, and a mass storage device **107**, such as a magnetic disk and associated disk drive, coupled with the bus **101** for storing information and instructions. A data storage medium **108** containing digital information is configured to operate with mass storage device **107** to allow processor **102** access to the digital information on data storage medium **108** via bus **101**.

Processor **102** may be any of a wide variety of general purpose processors or microprocessors such as the Pentium® microprocessor manufactured by Intel® Corporation. It will be apparent to those of ordinary skill in the art, however, that other varieties of processors may also be used in a particular computer system. Display device **105** may be a liquid crystal device, cathode ray tube (CRT), or other suitable display device. Mass storage device **107** may be a conventional hard disk drive, floppy disk drive, CD-ROM drive, or other magnetic or optical data storage device for reading and writing information stored on a hard disk, a floppy disk, a CD-ROM a magnetic tape, or other magnetic or optical data storage medium. Data storage medium **108** may be a hard disk, a floppy disk, a CD-ROM, a magnetic tape, or other magnetic or optical data storage medium.

In general, processor **102** retrieves processing instructions and data from a data storage medium **108** using mass storage device **107** and downloads this information into random access memory **103** for execution. Processor **102**, then executes an instruction stream from random access memory **103** or read-only memory **104**. Command selections and information input at input device **106** are used to direct the flow of instructions executed by processor **102**. Equivalent input device **106** may also be a pointing device such as a conventional mouse or trackball device. The results of this processing execution are then displayed on display device **105**.

Computer system **100** includes a network device **110** for connecting computer system **100** to a network. Network device **110** for connecting computer system **100** to the network includes Ethernet devices, phone jacks and satellite links. It will be apparent to one of ordinary skill in the art that other network devices may also be utilized.

Another embodiment of the present invention is implemented on a system known as WebTV, by WebTV Networks, Inc., Palo Alto. The WebTV system uses a standard television set as a display device for browsing the Web and connects to a conventional network, such as the Internet, using standard telephone, Integrated Services Digital Network (ISDN), or similar communication lines. A user of a WebTV client system can utilize WebTV network services provided by one or more remote WebTV servers. The WebTV network services can be used in conjunction with software running in a WebTV client system to browse the Web, send electronic mail, and to make use of the Internet in various other ways. The WebTV network uses a Hyper-Text Transport Protocol (HTTP) based set of protocols implemented within the Web and supported by one or more Web servers.

FIG. 1B illustrates a basic configuration of the WebTV network according to one embodiment. A number of WebTV clients **180** are coupled to a modem pool **170** via direct-dial, bi-directional data connections **175**, which may be telephone (POTS, i.e., "plain old telephone service"), ISDN (Integrated Services Digital Network), or any other similar type of connection. Modem pool **170** is coupled typically through a router, such as that conventionally known in the art, to a number of remote servers **150** via a conventional network infrastructure **165**, such as the Internet.

The WebTV system also includes a WebTV server **160**, which specifically supports the WebTV clients **180**. WebTV server **160** acts as a proxy in providing the WebTV client **180** with access to the Web and other WebTV services. More specifically, WebTV server **160** functions as a "caching proxy." A proxy cache on WebTV server **160** is used for temporary storage of Web documents, images, and other information which is used by frequently either the WebTV client **180** or the WebTV server **160**.

WebTV clients **180** each have a connection to the WebTV server **160** either directly, via a WebTV modem pool **175**, similar to modem pool **170**, or through the conventional modem pool **170** and the Internet **165**. Note that the modem pool **170** is a conventional modem pool, such as those found today throughout the world providing access to the Internet and private networks. Further details of the WebTV system, including the WebTV client can be found in co-pending U.S. Patent application entitled, "Web Browser Allowing Navigation Between Hypertext Objects Using Remote Control," having application no. 08/660,088, and filed on Jun. 3, 1996.

One embodiment of the present invention is implemented as a software module, which may be executed on a computer system such as computer system **100** or WebTV server **160** in a conventional manner. Using well known techniques, the application software of the preferred embodiment is stored on data storage medium **108** and subsequently loaded into and executed within computer system **100** or WebTV server **160**. Once initiated, the software of this embodiment operates in the manner described below.

FIG. 2A illustrates the variety of communications channels currently available to the typical home on-line service subscriber in an industrialized country such as the United States, Japan, or the United Kingdom. The arrows indicate the direction(s) of data flow over a given channel.

A user browsing the Internet today can select specific content such as web pages, video clips, audio clips or advertisements. This selected content is typically stored on servers on the Internet, identified in FIG. 2A as content server **210**. Since these content servers are usually maintained at commercial locations, very high bandwidth communications channels such a T1 or T3 lines are available to connect them to either a TCP/IP network, such as the Internet or a Virtual Private Network (VPN), or other packet-switched networks, such as X.25. Content servers may also be connected to conventional broadcast channels **200** including a CATV channel, a terrestrial channel, or a DBS channel. Because of the nature of these conventional broadcast channels **200**, however, they are typically limited to transmitting data in a single downstream direction, namely from the content server to the client.

Such content servers can be located at one site or at many sites throughout the world. In fact, it is quite possible to replicate such content servers in several locations so as to minimize the communications channel resources used by bringing a content server closer to each subscriber and to provide redundancy in the event of a server or communications failure.

FIG. **2B** illustrates a common configuration today for personal computer (PC) and network-enabled set-top boxes and video game consoles. Client network interface device (client device) **302** may include a device such as a WebTV™ set-top box, a video game system or a PC, that incorporates features described in computer system **100** above. Connected to client device **202** is a network interface device **224**, such as a POTS modem, an ISDN adapter, a cable modem or an ADSL modem. Also connected to client device **202** is caching store **220**. Caching store **220** may include a hard disk, a digital video disk (DVD), flash Read-Only Memory (ROM), or Random Access Memory (RAM). Other client devices, network interface devices and caching stores may also be utilized.

Network interface device **224** connects to a two-way wide-area network (WAN) **226**. According to one embodiment of the present invention, two-way WAN **226** is a switched telephone network (POTS or ISDN). ADSL, two-way cable plant, or other two-way network technology may also be utilized. Given the current infrastructure that is widely available for homes throughout the world, a POP is necessary to connect the home to the packet-switched WAN. Thus, as illustrated in FIG. **2B**, POP **206** connects the two-way WAN to a packet-switched WAN **230** such as a TCP/IP network (e.g. the Internet or a VPN) or an X.25 network. In the event that a packet-switched WAN **230** can be delivered directly to the home in the future, POP **206** will no longer be necessary. Finally, within reach of the packet-switched wide area network is at least one content server **210** containing content potentially of interest to the user of client device **202**.

Typically, the user of client device **202** decides that he or she is interested in certain content available on one or more content servers **210**. The user connects his or her client device **202** to a WAN such as the Internet or a private on-line service such as AOL™. This is generally accomplished by client software executing on client device **202** dialing the phone number of POP **206**, going through an authentication procedure to establish the validity of the user's on-line account, and then providing the user with an on-line navigation means. The on-line navigation means may be through a general-purpose Hyper-Text Markup Language (HTML) browser, such Netscape Navigator™ or Microsoft™ Internet Explorer, or through a proprietary on-line browser such as the AOL client software.

If the user is seeking a particular content item, there are various tools such a search engines and catalogs that the user can use to search for the content. Once that item is found, the user typically clicks the mouse on a hyperlink to that item. The hyperlink in turn directs the client software to initiate a download into their client device **202**. Depending on the data size of the content selected, the communications bandwidth, the network traffic, and the load on content server **210** holding the content, the download time may vary. The download may complete almost instantly or take minutes or hours. Upon completion of the download, the user may experience a visual result such as a picture or a video clip, or an auditory result such as music. Alternatively, the download may simply be a file that is stored in memory or on a disk for later use.

Although a download theoretically may complete very quickly, the typical experience of the home Internet or on-line service user is that downloads are very slow, even for relatively small data items. There are a number of factors that can make the download very slow, but even if all of the stages of the download are working at optimum efficiency, the home user is typically still limited to the bandwidth limitations of the switched telephone network.

ISPs such as AT&T WorldNet™ and WebTV Networks, Inc. offer flat-rate Internet access. While such flat rates are offered on the expectation of a certain average utilization of POP and network resources by the overall subscriber base, the ISP's primary concern is utilization during peak usage hours (Monday–Friday, 9 am–5 pm for business usage, evenings and weekend daytime for home usage). This is due to the fact that an ISP has a certain number of modems available in its POPs and a certain amount of bandwidth between its POPs and its servers to the Internet. The ISP must ensure that it has a sufficient number of modems and adequate bandwidth for peak usage. Otherwise, users will get busy signals or poor performance when they dial in for service during peak times. Thus, for an ISP to provide good service to its customer base, it must provide enough POP modems and enough bandwidth for peak usage.

Notably, an ISP's modem and bandwidth resources (collectively "ISP infrastructure") are largely idle during off-peak hours. Which hours of the day qualify as "off-peak hours" vary depending on a given ISP's customer base. In both the case of business and home customer base, however, traffic is typically light during late night and early mornings, 7 days a week in each time zone. During these hours, an ISP is amortizing equipment and paying for communications bandwidth on leased lines without utilizing the equipment. Thus, theoretically, if a large percentage of an ISP's user base were to connect to the ISP during these hours, it would have little or no impact on the ISP's costs of providing Internet access, so long as the number of users was less than its peak number of users, even though it would drastically increase the average number of on-line hours per month per user.

Following this supposition further, the telephone costs to the user for connecting during these off-peak hours would be zero or quite low, assuming the dialed POP was in a given user's local calling area. As described above, in the United States, residential local calls are generally charged at a flat-rate per month, regardless of duration. In other countries, local calls during off-peak hours are often cheaper than during peak hours. For example, in Japan, while local calls during peak hours are charged by the minute, a flat-rate service plan is available between the hours of 11 PM and 7 AM. Like the ISPs, phone companies must provide equipment and bandwidth to accommodate peak loads. During off-peak hours, this equipment and bandwidth sits idle, so the company may desire to incent users to utilize the equipment during these hours.

According to one embodiment of the present invention, the methods of on-line communications using the configuration shown in FIG. **1B** are improved significantly. The improvements take advantage of the fact that, as described above, typically in the home, a client device is utilized only during certain hours of the day. The presently claimed invention leverages the usage patterns to provide many of the characteristics of high-bandwidth two-way communications by heavily utilizing infrastructure during off-peak times.

In one embodiment of the present invention, the client software allows the user to specify content that the user

desires to access. For example, if the user is interested in news, the user might identify CNN™ Interactive, a web site that contains news items, as a web site of interest. During off-peak hours (when the user is probably asleep) the client software on client device **202** will direct client device **202** and network interface device **124** to automatically dial into to a local POP **132**, provide appropriate authentication, and then download all of the content the user has specified to be of interest. In the case of the CNN Interactive web site, the client software may explore all of the links originating from the root home page (i.e. http://www.cnn.com/) to some level of depth (e.g. to all pages within the cnn.com domain). As each web page comes in, its content will be stored in caching store **220**.

Some of the links may very well contain large quantities of data, such as compressed video, which using currently known techniques, is only convenient to download through a high bandwidth connection. Alternatively, according to this embodiment of the present invention, the client software will have several off-peak hours to complete the downloads and will thus be able to download these large data items over a standard lowbandwidth communications mechanism. For example, at 33.6 Kbps, 118 MBytes of data can be downloaded in 8 hours. 1 minute of MPEG 1 video is about 10 MBytes of data. Currently, a user with a 33.6 Kbps modem would wait almost an hour to download 1 minute of video. According to this embodiment, however, the user may specify this type of content to be downloaded overnight. The next day, the video may be viewed in real-time from caching store **220**.

The mechanism described above has significant advantages over currently available techniques. According to other embodiments of the present invention described below, further refinements provide for a better experience to the user and better resource utilization for the ISP.

A. Blind Downloads

One potential problem with the off-peak download mechanism just described is that if the client software blindly downloads content specified by the user, it may very well be downloading some of the same content redundantly every night. For example, the user may be interested in the CNN Interactive web site, but not all of the content on the CNN Interactive web site changes every night. Some of the graphical elements such as banners or user interface elements may remain unchanged for weeks or months at a time. Additionally, there are references to previous days' stories that may have been downloaded over the previous few days.

Thus, according to an embodiment of the present invention, data is selectively download into the Caching Store. There are numerous well-known techniques for determining whether on-line data has been previously cached, as well as certain proprietary techniques described in the co-pending application entitled "Method and Apparatus For Providing Proxying and Transcoding Of Documents In A Distributed Network," having Ser. No. 08/656,924, filed Jun. 3, 1996. If only new data is downloaded each night, then over several successive nights, a working set of current data may be captured which is much larger than the 118 MBytes that can be downloaded in a single 8 hour session at 33.6 Kbps.

B. Tracking Downloads

Another problem with the off-peak download mechanism and improvements just described is that it requires a proactive effort on the part of the user to specify which content the user is interested in. According to an embodiment of the present invention, the client software tracks the on-line usage of the user and logs a list of the sites the user visits. During the off-peak download, the client software can download updates to those sites, on the assumption that the user may be interested in going back to those sites at a later date.

C. Selecting Sites for Download

According to yet another embodiment of the present invention, the client software may consult with a database stored on a content server which categorizes sites by subject area, find sites that fall into the same general category as sites visited by the user, and download those sites during the off-peak downloads on the assumption that the user may be interested in similar category sites. For example, if the user is interested in NFL™ football and frequently visits www.nfl.com, the user may also be interested in the general sports information available at the ESPN™ website (www.espn.com). This embodiment may also include explicit selections provided by the user.

D. Organizing Download Material

According to another embodiment of the present invention, the ISP provides a service that organizes material chosen by an editorial staff (human or electronic) to download to the user based on any of the following criteria: (a) interests explicitly specified by the user (b) tracking which sites the user visits and extrapolating the user's interests (c) judgments made by the editorial staff of sites considered to be novelties or of general interest (d) payments made by third parties publishers of "high-end" web sites for data from their sites to be downloaded and cached permanently (e) payments made by third parties for advertisements to be downloaded and inserted during the user's browsing experience. It will be apparent to one of ordinary skill in the art that other download criteria may also be employed.

This embodiment includes client and server side software. The client software connects to the ISP server software prior to starting its off-peak content download. The client software uploads relevant information to the server, such as explicitly specified interests of the user and user tracking information. The server software downloads to the client software a list of addresses of content to be downloaded during the off-peak download, based on the criteria described above. The caching store **220** can thus be customized to store content explicitly or implicitly in the user's interest.

E. Downloading Advertising

The caching store **220** can also store promotional content such as advertisements or particular web sites which third parties are willing to pay the ISP for the right to download and make available to the user. Presumably, such payments will reduce the ISPs operating costs and the savings can be passed along to the user in the form of reduced on-line costs. In this sense, such promotional content would serve a similar purpose to advertising on television: it would make content available to the user for a reduced cost, or for free.

According to one embodiment of the present invention, downloaded advertising is presented to the user in many forms. For example, the advertising can be placed as a "banner" on the screen amidst other content, or it could interrupt the user's browsing and be displayed periodically, just as TV ads interrupt the user's TV watching. The advertising can also be displayed while the user is visiting "free" sites, but suppressed while the user is visiting "premium" sites, namely sites that the user pays a monthly fee to view. Additionally, such advertising can be suppressed if the user pays a higher fee to the ISP.

Thus, according to this embodiment, advertising can be targeted more specifically to the user's interests using cri-

teria similar to that used for selecting content to be downloaded to the user. Thus, unlike broadcast television where users must endure advertising directed to a fairly general audience, an embodiment of the present invention allows for improved, less intrusive, better targeted or non-existent (if the user is willing to pay a higher subscription fee) advertising.

Current Internet advertising generally connects the advertisement with a particular web page, usually in the form of a banner. If web pages containing such banners are cached in a caching store **220**, several problems may arise. For example, each time the user returns to the cached web page, the same banner will be displayed. This is a disadvantage over current methods of displaying banners where banner ads change each time a web page is displayed. Additionally, if a web page is cached and the user never goes to it, any banner advertisement stored together with the web page is wasting cache space and download time.

Thus, according to one embodiment of the present invention, advertisements are stored separately from web pages and are inserted periodically during the user's browsing (regardless of what web page the user goes to). This embodiment thus allows the advertisements to change throughout the browsing experience, while optimizing the cache space and download time. This embodiment also allows the advertisements to be better targeted to the user's interests because the ads are targeted based on all of the data known about the user, not simply the fact the user is viewing a given web page. Finally, this embodiment makes it possible for the user to suppress advertising altogether by paying a higher fee to the ISP.

F. Downloading Updates

According to one embodiment, a variety of data may be transmitted during off-peak hours. For example, users may be allowed to schedule software updates during these hours. While a user is logged in during the day, the user may be presented with the option of upgrading various software on his or her client machine. If the user selects the upgrade, the user may then be presented with the option of having the upgrade downloaded during off-peak hours, thus reducing the amount of time that the user is logged on to the network during peak hours. This is especially advantageous for large downloads that may require prolonged connectivity. It will be appreciated by one of ordinary skill in the art that other types of data may also be downloaded during these off-peak hours.

G. Purchasing Bandwidth and Caching Store Space

According to another embodiment of the present invention, web site publishers can "purchase" bandwidth and caching store **220** space. These web sites can thus ensure that data from their sites is always available to the user. This embodiment allows high-end content providers, such as Disney™ or ESPN, to present a richer experience with their web sites than would otherwise be possible. For example, instead of a user seeing still images and text when they go to the www.disney.com home page (since the Disney web site designers were limited to an amount of data that can download in a few seconds with a 33.6 Kbps modem), the user could be greeted with full-motion video and sound upon reaching the web site. Anything that requires a large download during the night could not be completely up-to-date, but text or other low-bandwidth data elements could download at the 33.6 Kbps rate when the user goes to the site to be overlaid upon the previously cached high-bandwidth data. Thus, visually rich "stock footage" from the caching store **220** can be combined with completely current data downloaded at the time the site is visited to provide a compelling and up-to-date experience for the user.

H. Coordinated Multicast Downloads

Although the previously described embodiments work well for an individual client device **202**, there are scalability issues that crop up when there are hundreds of thousands or millions of client devices **202**. Although each individual client device **202** would typically require a relatively low-bandwidth data stream (e.g. 33.6 Kbps), one million client devices **202** being simultaneously updated would have an aggregate bandwidth requirement of 33.6 Gigabits/sec. If a significant number of these client devices **202** are attempting to download data from a single content server **210** at once, the server would be overwhelmed and many of client devices **202** would have to wait until the server is available. Additionally, if many of client devices **202** are utilizing any common communications channel simultaneously (e.g. a T1 line leading into a single POP serving many client devices **202**), that channel can also become overwhelmed resulting in communications delays. The amount of data that can be downloaded overnight is directly proportional to the percentage of time client device **202** communications channel is active. Thus it is clearly desirable to avoid overloading content servers and shared communications channels so as to minimize client device **202** wait time and maximize the amount of data downloaded.

One embodiment of the present invention coordinates downloads through one or more content servers on the network, utilizing a "multicast" transmission protocols, rather than having data downloads initiated by each client device **202** independently. Some particular multicast protocols are well known in the art and are generally intended to provide live broadcasts of data through a network (e.g. a TCP/IP network such as the Internet), typically for the purpose of disseminating media format data such as sound or video in real-time. For example, multicast protocols can be used to transmit compressed audio or video from a baseball game in progress. Whereas typical TCP/IP communications are one-to-one, multicast communications are one-to-many. Multicast protocols on the Internet allow a bandwidth "slot" to be reserved in advance for the multicast on all the routers carrying the multicast data. Thus, the server generating the multicast can be certain that any client desiring to receive the multicast will be able to do so without a break in the communications, despite adverse traffic conditions on the Internet.

One embodiment of the present invention uses TCP/IP multicast protocols to disseminate data as follows. At a pre-established time, all client devices **202** desiring to be updated connect to the Internet. Each client device connects to a server at a pre-established IP address and downloads information as to what data feeds are available, when they are available, the nature of the data, and the multicast addresses where the data can be accessed. Based on the particular profile(s) of the user(s) of a given client device **202** and an assessment of which data has already been downloaded to client device **202** during previous sessions, client device **202** software makes a determination of which data feeds are most relevant for the user and contain new data which has not previously been downloaded. Then, at the appointed times client device **202** begins to the receive the appropriate data streams.

The data streams used by the presently preferred embodiment can come in several forms, as illustrated in FIGS. **3A–3D**. A simple organization is shown in FIG. **3A**. Five data streams are shown in this figure (data streams

302–310), each containing data focused on a particular area of interest. The data streams are each 8 hours of a steady download at a given data rate, in this example, 33.6 Kbits/sec. If the five data streams shown here were available on a given night and the user of a client device **202** were interested in Sports data stream **306**, client device **202** could then connect to the Sports multicast data stream **306** at 11 PM, and commence downloading into its caching store **220**. By 7 AM, if there were no disruptions, client device **202** would have downloaded approximately 118 MBytes of Sports-orient content, which might include video and audio clips, images, text and interactive content. The user would be able to enjoy this Sports content during the day and would benefit from near instant access since the data would be stored on its caching store **220**. Of course, if client device **202**'s user were more interested in News, or Children's content, then the Client could download the News multicast data stream **308** or Children's multicast data stream **310** instead.

Clearly, there could be millions of client devices **202** simultaneously downloading data from multicast data streams, while imposing little burden on either the content server **210** supplying the data streams or Internet communications infrastructure carrying the multicast. The five data streams together constitute only 33.6 Kbits/sec*5=168 Kbits/sec of data bandwidth, a minor burden on either content server **210**, or a T1 or a T3 line, especially during off-peak hours. Thus, compared to a million client devices **202** simultaneously requesting individual 33.6 Kbit/sec data streams (resulting in 33.6 Gigabits/sec of aggregate bandwidth), this embodiment results in a much lower aggregate bandwidth.

I. Retransmissions

One limitation to the approach described above is that the communications infrastructure through the Internet and through telephone dial-up connections is imperfect. Packets are dropped, routers have throughput problems, phone connections are dropped, etc. Additionally, the user may choose to use client device **202** during some portion of the designated download hours. Thus, client device **202** may not be available for downloading if it is being used for another purpose. Further, since a residential telephone line is often used for more than one use, the telephone line may be engaged during a portion of the download hours, blocking client device **202** from using it.

Thus, it is essential that the data streams are structured appropriately to allow for the fact that some client device **202**s may not receive a perfect uninterrupted data stream. There are a number of approaches that can be applied to this problem. As shown in FIG. **3B**, data can be transmitted repeatedly, staggered by some period of time. The same Sports information could be transmitted every hour, as shown in the Sports **1** data stream. If a Client device **202** whose user is interested in Sports receives a bad packet or is disrupted during a download of Sports **1**, it simply can wait for hour later to receive the same data again. It will be appreciated by one of ordinary skill in the art that the retransmitted data may be staggered by any appropriate period of time (i.e. greater or less than one hour).

Repeating Sports **1** data reduces the amount of Sports data that can be transmitted over the eight hour period. If Sports was an important enough category, however, one or more additional data streams could be allocated to Sports information. In this example, as illustrated in FIG. **3B**, two data streams are allocated to Sports, Sports **1** and Sports **2**, each repeating every hour. The repeating data gives ample opportunity for a Client device **202** to download data in subsequent hours if there are any transmission errors (corrupt or missed data packets). Unless there are extremely unreliable communications or if client device **202** or the phone line is tied up for many hours during the download period, client device **202** should have no trouble downloading an hour of Sports **1** and an hour of Sports **2** during the eight hour period.

Some users may be interested in more than one subject area. In this case client device **202** could utilize the repeating data streams shown in FIG. **3B** to receive a selection of several content areas. For example, if the user were interested in Fashion, Sports and News, the Client device **202** may download one hour from each data stream for four hours. Also, for one hour, client device **202** may download Advertising (which could be used to help pay for the cost of the other content). In the remaining hours client device **202** may download any data packets that were corrupted or missed in the preceding hours.

This embodiment of the present invention is distinct from current advertising on the Internet, where the advertising is downloaded from a web site, typically in the form of a "banner" associated with a particular Web page. In the current embodiment, advertising can be downloaded as a separate data stream into client device **202**. When the user uses client device **202** to view web sites, client device **202** can overlay advertising over any web page, or display advertising between web pages, or while web pages are loading, if, for example, they are not stored in the caching store **220**. In this way, an advertiser can be certain its ad is viewed by a user, regardless of which web sites they decide to visit. There is also no bandwidth wasted downloading advertisements tied to particular content that may never be viewed.

Another embodiment of the present invention provides more efficient correction of sporadic transmission errors. Given that Internet communications and high-speed modem communications are for the most part reliable, there should be a relatively small number of data errors during the download of multicast data, and these errors will tend to be sporadic. Consequently, it would not be efficient for client device **202** to sacrifice an entire hour of download time just so it can wait for the retransmission of a packet that was corrupted in the previous hour of a data stream. Moreover, it may be the case that the packet downloads with the same error again, or that there are packet errors in more than one data stream which occur at the same moment during an hour, and therefore cannot both be received at once if only one hour is allocated to correct all errors.

Several improvements in this embodiment alleviate these problems. For one, the repetition interval of the data streams can be made to be smaller with more data streams allocated. This gives more opportunity to correct errors, but it has the disadvantage of using more bandwidth. An alternative improvement is to allocate a block of time for client devices **202** to make individual retries of a conventional nature as shown in FIG. **3C**. For example, if a client device **202** downloads data from all five data streams and there were a total of **10** data errors over the course of the downloads, client device **202** may request the content server **210** supplying the data streams to send the particular **10** packets that were dropped in the multicast. If one million client devices **202** receiving multicast data streams all suffer from **10** data errors, there will be **10** million retry requests to content server **210**. Although this is a large number of requests, the requests do no necessarily need to be answered instantly, and client devices **202** can wait until it is their turn to have their requests filled.

Yet another improvement is shown in FIG. 3D. As previously described, a block of time is allocated for client devices **202** to make retry requests to content server **210** supplying the data stream. But, rather than responding directly to the requesting client device **202**, content server **210** transmits the repeated data on the appropriate multicast data stream. In this way other client devices **202** that experienced the same error will be able to receive the corrected data. This is more efficient than sending individual responses because it is often the case that the same data packet error may affect several recipients of a multicast (e.g. if several client devices **202** are downstream from the same network node that causes the data packet error).

J. Conditional Viewing Restrictions

Certain content that is downloaded using the mechanisms just described may be intended for viewing only by a user paying a special fee. According to one embodiment, client device **202** downloads such so-called for-pay content, but does not allow the user to view the data unless certain conditions are met such as, for example, the transferring of funds to the account of the owner of the for-pay content. Another condition permitting the viewing of the for-pay content might be a trial offer whereby the user may preview part of the for-pay content, but must pay for viewing the rest of the for-pay content.

K. Call Waiting Interrupt

One problem with client device **202** doing an eight-hour download of data through a residential telephone line is that, although the download might occur during times when the user is sleeping, another party might want to reach the user in an emergency. Most United States telephone lines are equipped with a Custom Calling feature known as Call Waiting which introduces a "bong" sound to a telephone call when a third party is calling. By "flashing" the switchhook, the telephone call can be put on hold and the third party will be connected. This Call Waiting capability can be used to allow an incoming call to interrupt a long data download as described in copending patent application entitled "Method and Apparatus For Managing Communications Between A Client And A Server In A Network," having Ser. No. 08/660,087, filed Jun. 3, 1996. The lost data packet recovery mechanisms described previously can be used to recover packets lost during such Call Waiting disruptions.

L. Off-peak Downloads

Although the data download mechanisms described above provide a means to download a great deal of data during off-peak times, a characteristic of this approach is that the data downloaded is not completely up-to-date when the user views it. For example, a news clip that is downloaded at 2 AM and viewed at 6 PM may not be as interesting to the viewer as something more current. A further improvement to the presently preferred embodiment is for client device **202** to utilize any channel idle time when the user is using client device **202** to download any updates to the data that was downloaded previously.

Thus, a clear distinction can be drawn between prior art utilization of idle time and off-peak time on a network, as illustrated in FIG. **4**, and improved utilization of idle time and off-peak time on a network, as illustrated in FIG. **5**. In FIG. **4**, no data is transmitted when the user is connected, but idle, nor is any data transmitted during off-peak time of the day. As can be seen in FIG. **5**, a great deal of data (described here as auxiliary data) is transmitted during off-peak times of the day and updated with data transmitted during idle time.

Thus, a method and apparatus for transmitting high bandwidth network content on a low bandwidth communications channel during off peak hours is disclosed. The specific arrangements and methods described herein are merely illustrative of the principles of the present invention. Numerous modifications in form and detail may be made by those of ordinary skill in the art without departing from the scope of the present invention. Although this invention has been shown in relation to a particular preferred embodiment, it should not be considered so limited. Rather, the present invention is limited only by the scope of the appended claims.

What is claimed is:

1. In a computer network that includes (i) a plurality of remote servers for accessing a plurality of network sites containing various types of content that can be viewed and downloaded, (ii) a plurality of proxy servers for caching content from frequently accessed sites of one or more of the remote servers, and (iii) a plurality of client systems each having a caching store to which requested content of one or more sites on the network can be downloaded from any of the remote or proxy servers, and wherein each of the remote servers, proxy servers and client systems are logically connected to one another over a plurality of communications channels, at least some of which are low bandwidth communication channels, a method of improving transmission of network content by utilizing off peak as opposed to peak time periods for downloading selected content, comprising the steps of:

tracking at the client system on-line usage of a user in the form of information that corresponds to one or more sites and/or the content contained at such sites accessed by the user;

during an off peak time period, the client system automatically and without user intervention, connecting to at least one of said remote or proxy servers, and authenticating to the connected server the client system that is connecting;

thereafter, during the off peak time period, downloading from the connected server content from one or more sites on the network as identified from the information tracked at the client system; and

storing the downloaded content in the caching store of the client system, and then disconnecting the client system prior to return of the peak time period.

2. The method according to claim **1** wherein said step of downloading said context from one or more sites during off-peak hours includes the step of downloading advertising data.

3. The method according to claim **2** wherein said step of downloading said advertising data includes the step of storing said downloaded advertising data separately from other downloaded content.

4. The method according to claim **2** wherein said step of downloading said advertising data includes the step of allowing users to prevent downloading advertising data.

5. The method according to claim **1** wherein at least one of said communications channels is a telephone network.

6. The method according to claim **1** wherein at least one of said communications channels is an Integrated Services Digital Network (JSDN) network.

7. A method according to claim **1**:

wherein said step of connecting to said at least one remote or proxy servers includes the acts of receiving on said at least one server download requests from a plurality of client systems on said network, and storing said download requests on said server for user during a coordinated multicast; and

wherein said step of downloading content includes the act of broadcasting said coordinated multicast from said server to said plurality of clients at a predetermined time.

8. The method according to claim 7 further including the steps of:

said plurality of client systems assessing individual user profiles and previously downloaded data; and

generating said requests based on the assessed individual user profiles and previously downloaded data.

9. The method according to claim 7 wherein said act of broadcasting said coordinated multicast from said server to said plurality of client systems at said predetermined time includes the act of broadcasting streams of data from said server to said plurality of clients.

10. The method according to claim 9 wherein said act of broadcasting streams of data from said server to said plurality of client systems includes the act of rebroadcasting streams of data from said server to said plurality of client systems at predetermined times after said broadcast.

11. In a computer network that includes (i) a plurality of remote servers for accessing a plurality of network sites containing various types of content that can be viewed and downloaded, (ii) a plurality of proxy servers for caching content from frequently accessed sites of one or more of the remote servers, and (iii) a plurality of client systems each having a caching store to which requested content of one or more sites on the network can be downloaded from any of the remote or proxy servers, and wherein each of the remote servers, proxy servers and client systems are logically connected to one another over a plurality of communications channels, at least some of which are low bandwidth communication channels, as an article of manufacture, computer program product for utilization on a client system in order to implement a method of improving transmission of network content by utilizing off peak as opposed to peak time periods for downloading selected content, said computer program product comprising:

computer readable medium for containing computer program code means; and

wherein the computer program code means comprise instructions for operating a client system in accordance with a method which is comprised of the steps of:

tracking at the client system on-line usage of a user in the form of information that corresponds to one or more sites and/or the content contained at such sites accessed by the user;

during an off peak time period, the client system automatically and without user intervention, connecting to at least one of said remote or proxy servers, and authenticating to the connected server the client system that is connecting;

thereafter, during the off peak time period, downloading from the connected server content from one or more sites on the network as identified from the information tracked at the client system; and

storing the downloaded content in the caching store of the client system, and then disconnecting the client system prior to return of the peak time period.

12. The method as implemented by the computer program product according to claim 11 wherein said step of downloading context from said one or more sites during off-peak hours includes the step of downloading advertising data.

13. The method as implemented by the computer program product according to claim 12 wherein said step of downloading said advertising data includes the step of storing said downloaded advertising data separately from other downloaded content.

14. The method as implemented by the computer program product according to claim 12 wherein said step of downloading said advertising data includes the step of allowing users to prevent downloading advertising data.

15. The method as implemented by the computer program product according to claim 11 wherein at least one of said communications channels is a telephone network.

16. The method as implemented by the computer program product according to claim 11 wherein at least one of said communications channels is an Integrated Services Digital Network (JSDN) network.

17. A method as implemented by the computer program product according to claim 11:

wherein said step of connecting to said at least one remote or proxy servers includes the acts of receiving on said at least one server download requests from a plurality of client systems on said network, and storing said download requests on said server for use during a coordinated multicast; and

wherein said step of downloading content includes the act of broadcasting said coordinated multicast from said server to said plurality of clients at a predetermined time.

18. The method as implemented by the computer program product according to claim 17 further including the steps of:

said plurality of client systems assessing individual user profiles and previously downloaded data; and

generating said requests based on the assessed individual user profiles and previously downloaded data.

19. The method as implemented by the computer program product according to claim 17 wherein said act of broadcasting said coordinated multicast from said server to said plurality of client systems at said predetermined time includes the act of broadcasting streams of data front said server to said plurality of clients.

20. The method as implemented by the computer program product according to claim 19 wherein said act of broadcasting streams of data from said server to said plurality of client systems includes the act of rebroadcasting streams of data from said server to said plurality of client systems at predetermined times after said broadcast.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 5,978,381

DATED : November 2, 1999

INVENTOR(S) : Stephen G. Perlman, William H. Yundt, Stuart Schneck

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 2, ln. 55: after "as well" insert --as--

Col 4, ln. 58: after "channels such" change "a" to --as--

Col 5, ln. 54: after "such" change "a" to --as--

Col. 9, ln. 28: after "the fact" and before "the" insert --that--

Col. 10, ln. 62: after "begins to" delete [the]

Col. 12, ln. 12: after "user" change "were" to --was--

Col. 12, ln. 65: after "requests do" change "no" to --not--

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 5,978,381

DATED : November 2, 1999

INVENTOR(S) : Stephen G. Perlman, William H. Yundt, Stuart Schneck

It is certified that error appears in the above-indentified patent and that said Letters Patent is hereby corrected as shown below:

Col. 14, ln. 46: after "context from" and before "one" insert --said--

Col. 14, ln. 60: after "Network" change "(JSDN)" to --(ISDN)--

Col. 15, ln. 3: after "clients at" change "a" to --said--

Col. 16, ln. 24: after "Network" change "(JSDN)" to --(ISDN)--

Col. 16, ln. 35: after "clients at" change "a" to --said--

Col. 16, ln. 48: after "data" change "front" to --from--

Signed and Sealed this

Third Day of April, 2001

Attest:

Nicholas P. Godici

NICHOLAS P. GODICI

Attesting Officer

Acting Director of the United States Patent and Trademark Office

US005181107A

United States Patent [19]

Rhoades

[11] Patent Number: 5,181,107

[45] Date of Patent: * Jan. 19, 1993

[54] TELEPHONE ACCESS INFORMATION SERVICE DISTRIBUTION SYSTEM

[75] Inventor: Donald E. Rhoades, Miami, Fla.

[73] Assignee: Interactive Television Systems, Inc., Miami, Fla.

[*] Notice: The portion of the term of this patent subsequent to Sep. 24, 2008 has been disclaimed.

[21] Appl. No.: 763,301

[22] Filed: Sep. 20, 1991

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 423,946, Oct. 19, 1989, Pat. No. 5,051,822.

[51] Int. Cl.[5] H04H 1/02

[52] U.S. Cl. 358/86; 455/4.2; 455/5.1; 455/6.2

[58] Field of Search 455/3, 4, 5, 6, 3.1, 455/3.3, 4.1, 4.2, 5.1, 6.2, 6.3; 358/84, 86, 1.4

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5,051,822	9/1991	Rhoades	455/4

Primary Examiner—Reinhard J. Eisenzopf
Assistant Examiner—Lisa D. Charouel
Attorney, Agent, or Firm—Jacobson, Price, Holman & Stern

[57] ABSTRACT

A digital, interactive communication system designed to provide a plurality of remote subscribers with any one of a variety of stored information service software packages through the use of a home computing assembly maintained within the subscriber's home and structured to display video as well as generating audio on a standard television receiver. A bi-directional communication link is established over telephone lines between the home computing assembly and a central remote information storage center wherein a selected one of the variety of information services is transmitted as a modulated carrier to the subscriber. Information service selection is controlled by a remote information storage center executive software program. Automatic billing is performed by computing equipment maintained in the remote information storage center and transmitted to a headquarters which also receives diagnostic messages associated with the remote information center and/or the associated plurality of home computing elements.

20 Claims, 12 Drawing Sheets

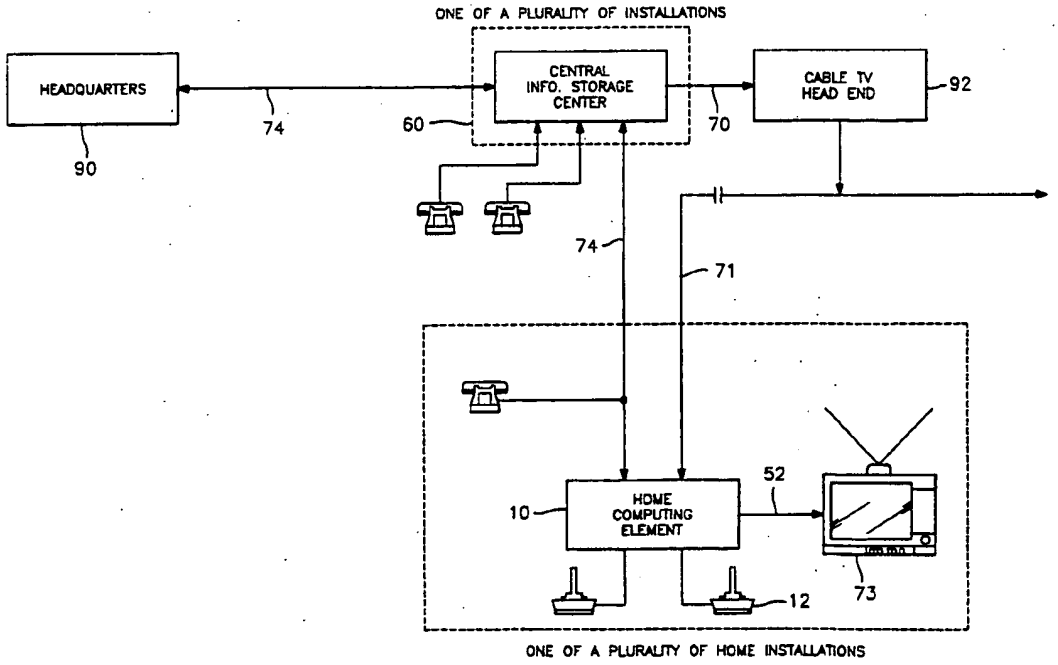


FIG. 1

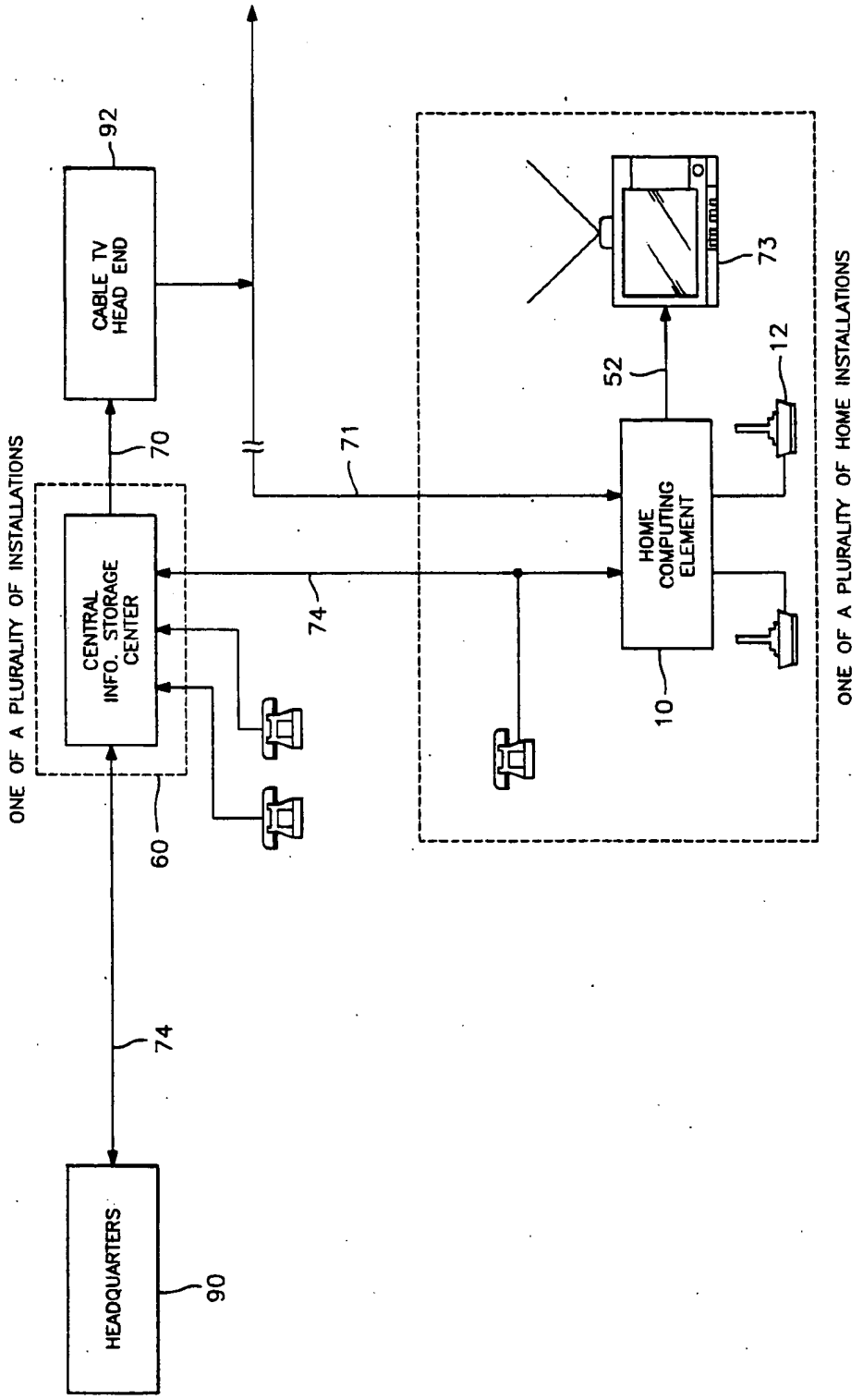

92
CABLE TV HEAD END
70
71
ONE OF A PLURALITY OF INSTALLATIONS
CENTRAL INFO. STORAGE CENTER
60
74
74
HEADQUARTERS
90
73
52
12
HOME COMPUTING ELEMENT
10
ONE OF A PLURALITY OF HOME INSTALLATIONS

FIG. 2

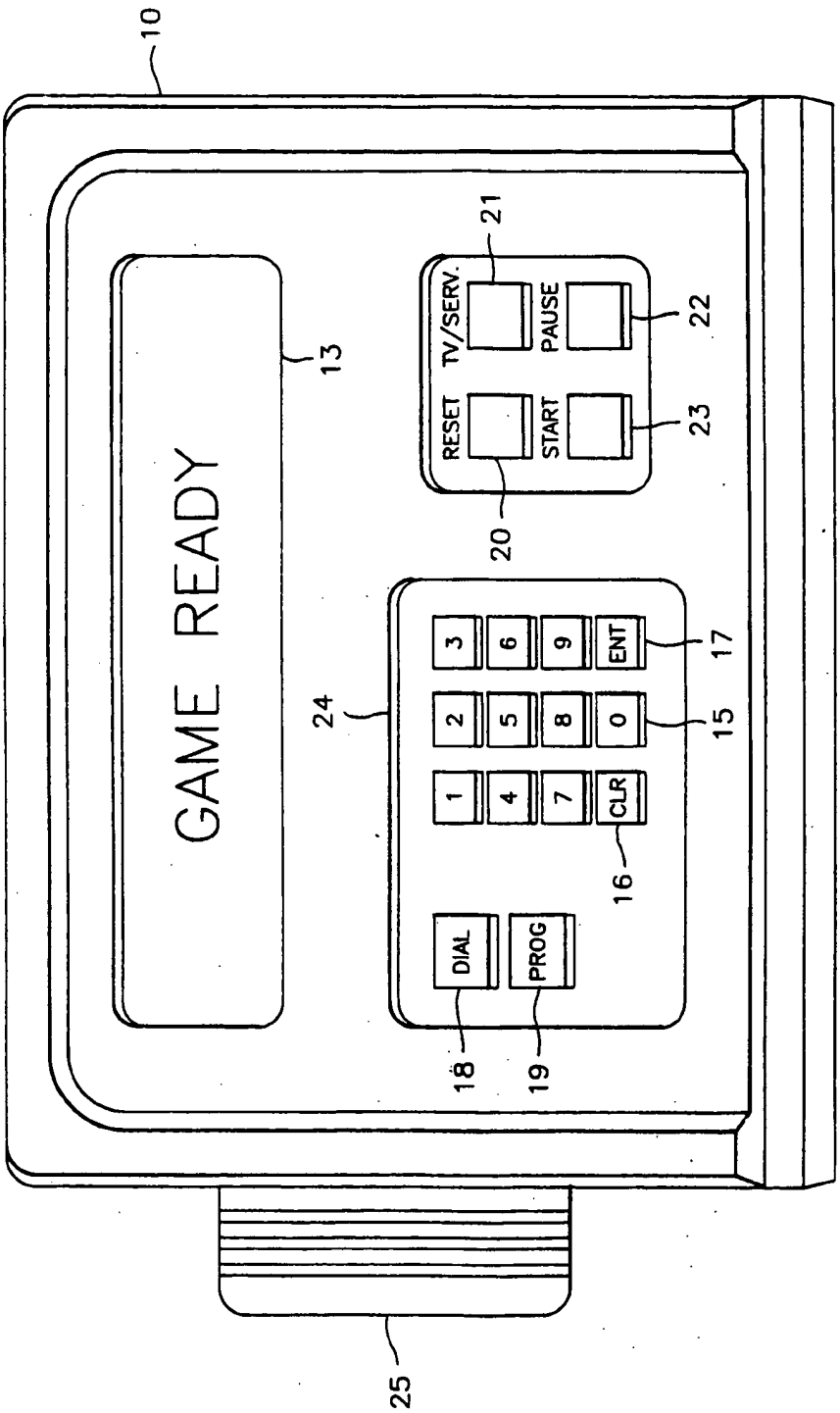

10
GAME READY
13
21
TV/SERV.
PAUSE
22
RESET
START
23
20
24
3
6
9
ENT
17
2
5
8
0
15
1
4
7
CLR
16
DIAL
PROG
18
19
25

FIG. 3

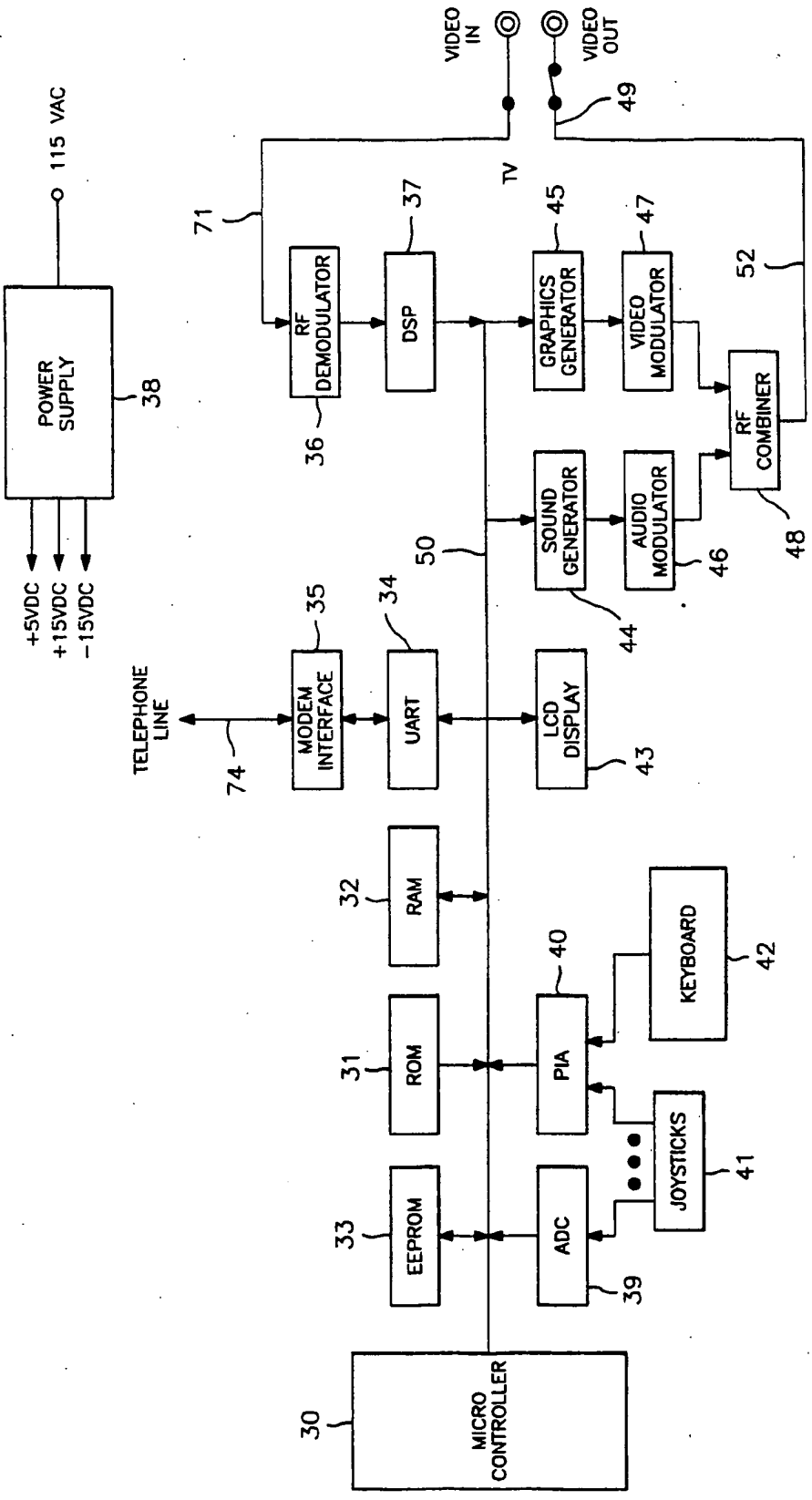

115 VAC
POWER SUPPLY
38
+5VDC
+15VDC
-15VDC
VIDEO IN
VIDEO OUT
49
TV
71
RF DEMODULATOR
36
DSP
37
GRAPHICS GENERATOR
45
VIDEO MODULATOR
47
52
RF COMBINER
48
SOUND GENERATOR
50
AUDIO MODULATOR
46
44
TELEPHONE LINE
74
MODEM INTERFACE
35
UART
34
LCD DISPLAY
43
RAM
32
ROM
31
PIA
40
KEYBOARD
42
EEPROM
33
ADC
39
JOYSTICKS
41
MICRO CONTROLLER
30

FIG. 4

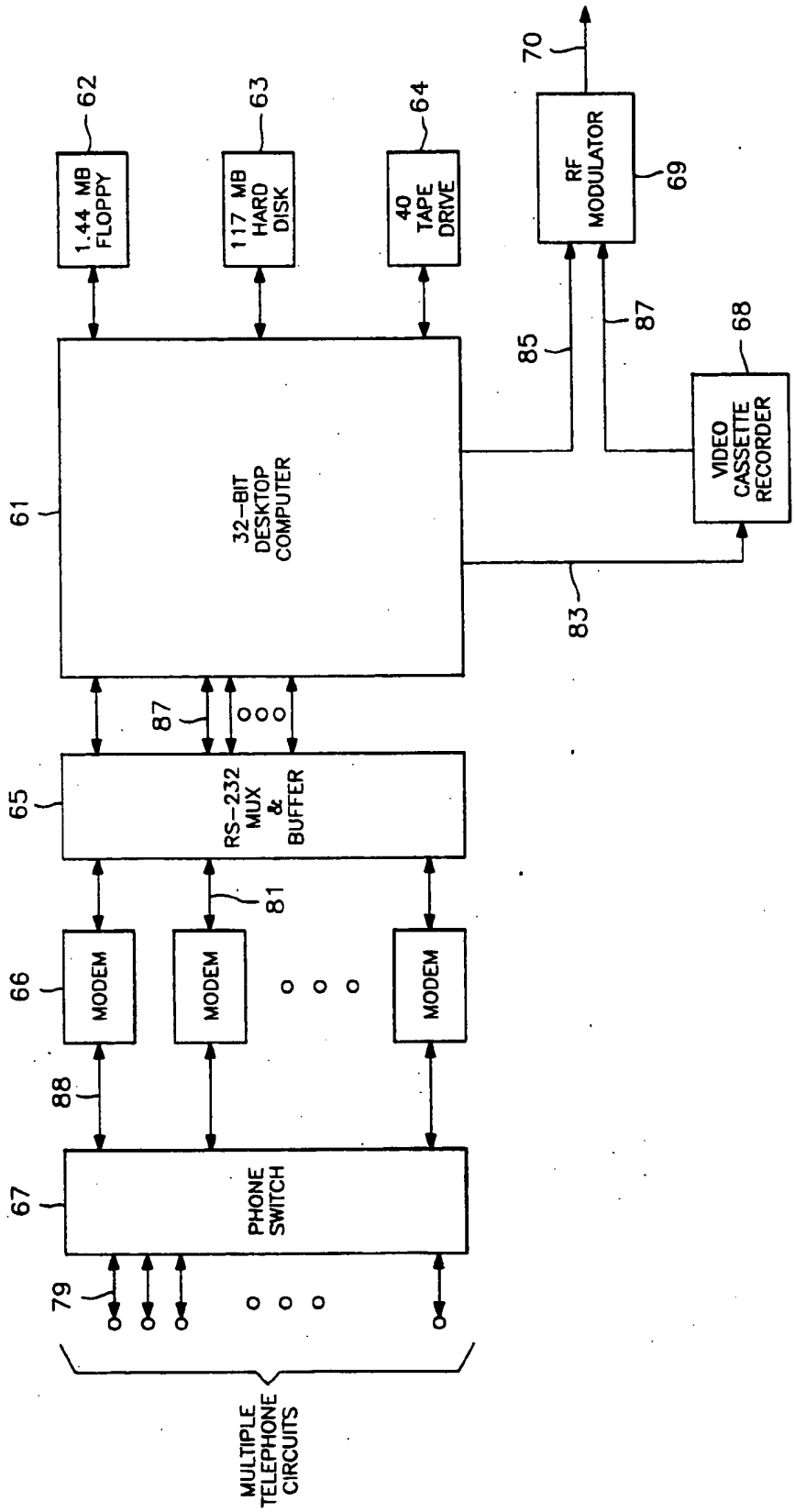

62
1.44 MB FLOPPY
63
117 MB HARD DISK
64
40 TAPE DRIVE
70
RF MODULATOR
69
85
87
68
VIDEO CASSETTE RECORDER
61
32-BIT DESKTOP COMPUTER
83
87
65
RS-232 MUX & BUFFER
81
66
MODEM
MODEM
MODEM
88
67
PHONE SWITCH
79
MULTIPLE TELEPHONE CIRCUITS

FIG. 5

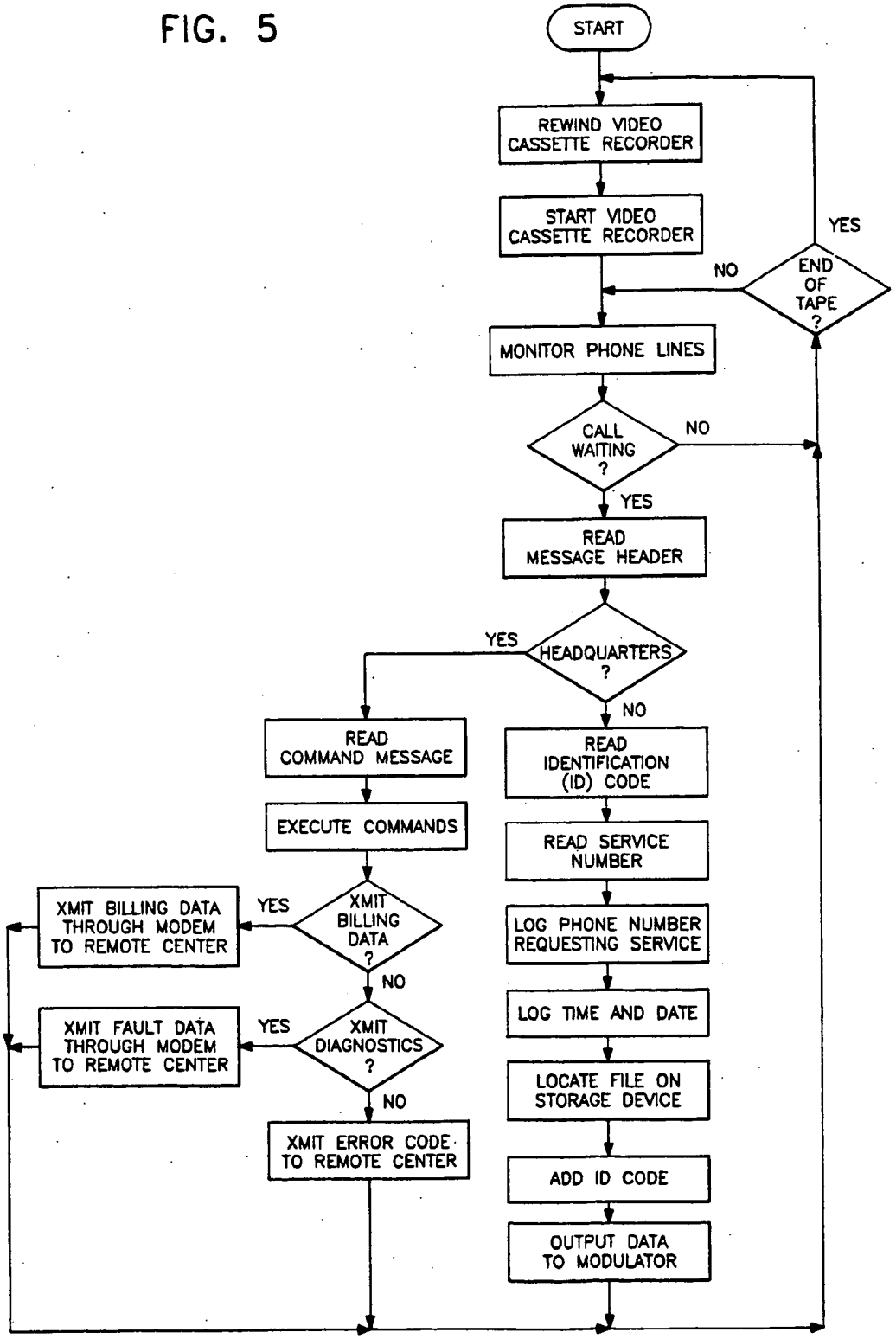

START
REWIND VIDEO CASSETTE RECORDER
START VIDEO CASSETTE RECORDER
END OF TAPE ?
YES
NO
MONITOR PHONE LINES
CALL WAITING ?
NO
YES
READ MESSAGE HEADER
HEADQUARTERS ?
YES
NO
READ COMMAND MESSAGE
EXECUTE COMMANDS
XMIT BILLING DATA ?
YES
XMIT BILLING DATA THROUGH MODEM TO REMOTE CENTER
NO
XMIT DIAGNOSTICS ?
YES
XMIT FAULT DATA THROUGH MODEM TO REMOTE CENTER
NO
XMIT ERROR CODE TO REMOTE CENTER
READ IDENTIFICATION (ID) CODE
READ SERVICE NUMBER
LOG PHONE NUMBER REQUESTING SERVICE
LOG TIME AND DATE
LOCATE FILE ON STORAGE DEVICE
ADD ID CODE
OUTPUT DATA TO MODULATOR

FIG. 6

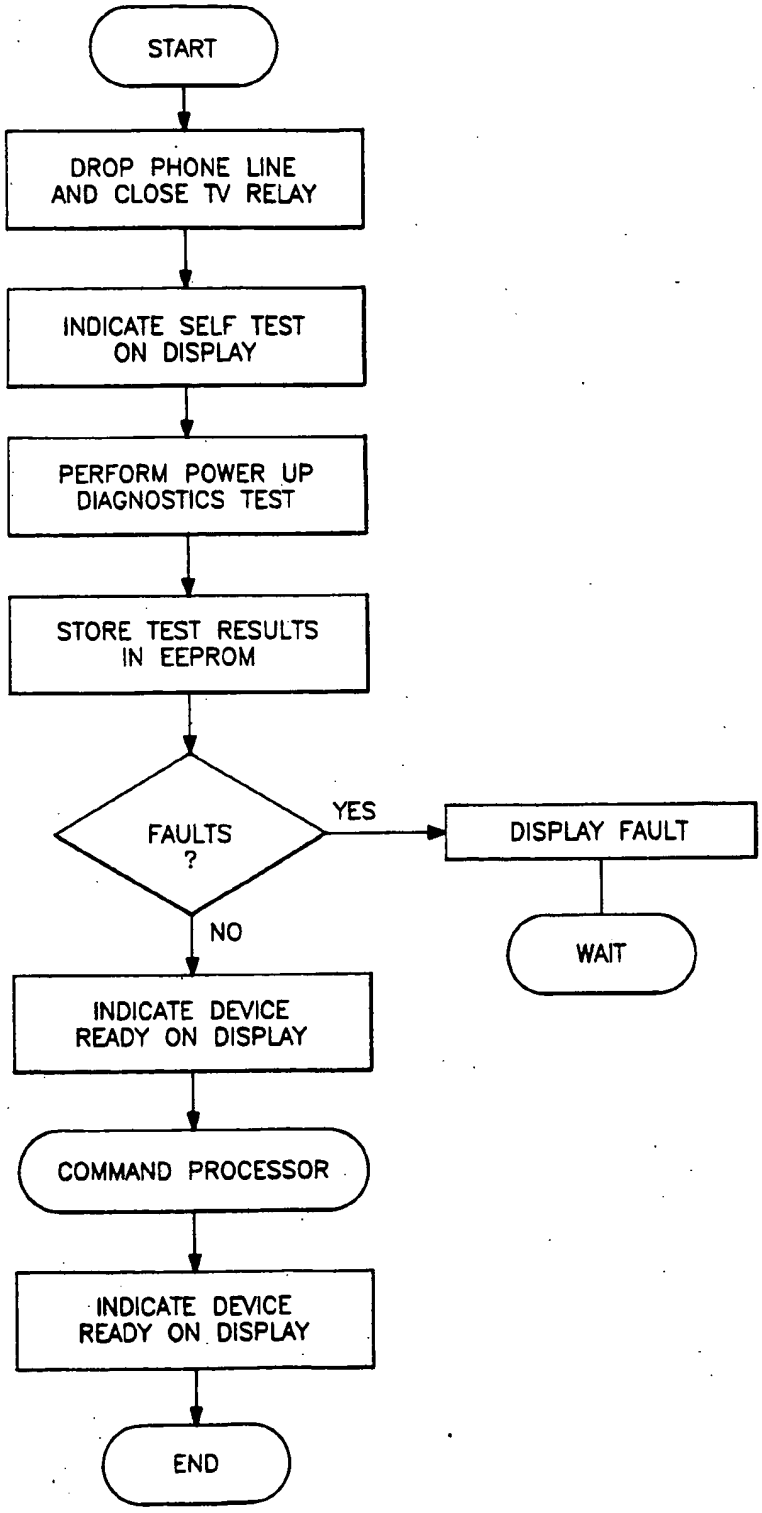


FIG. 7

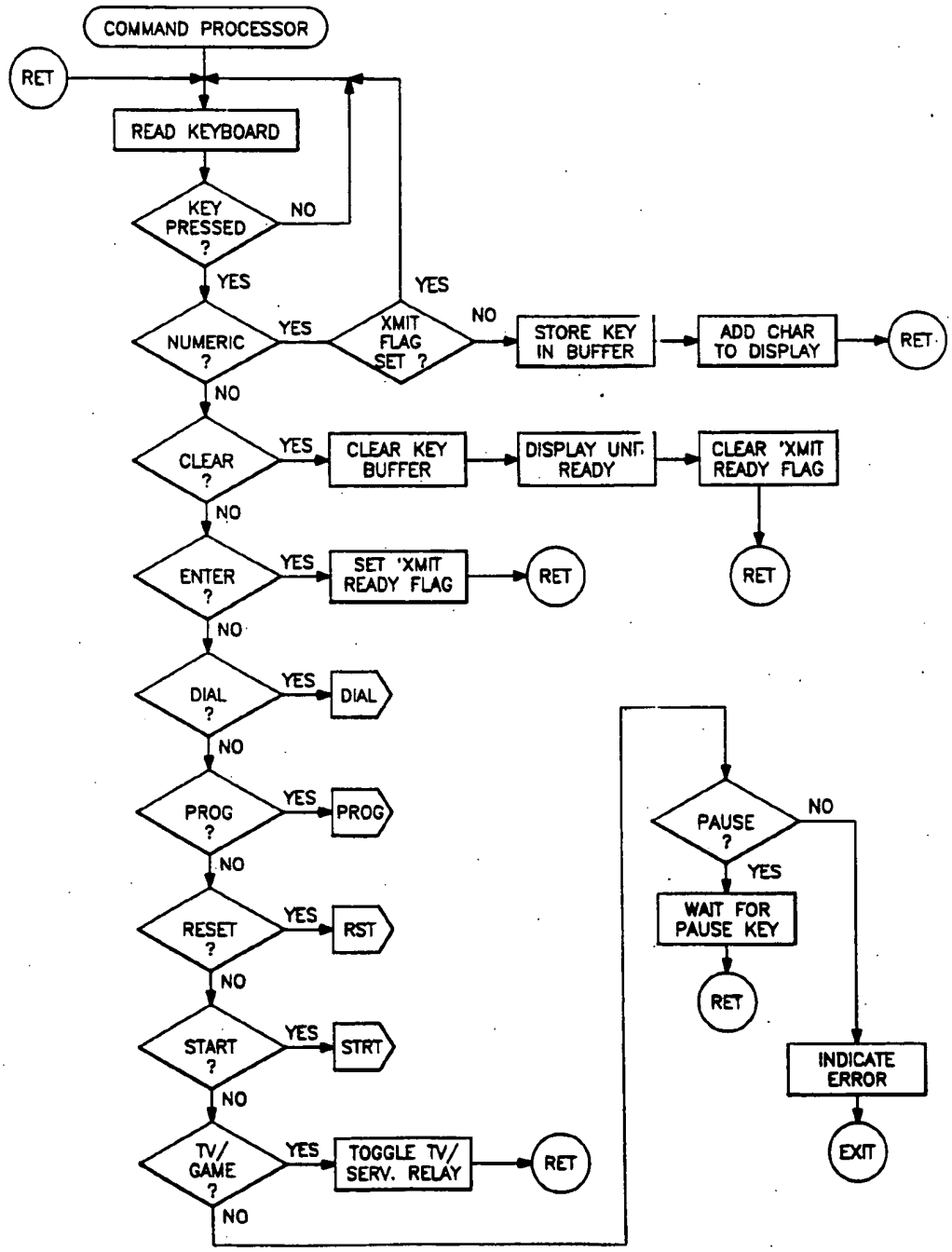

COMMAND PROCESSOR
RET
READ KEYBOARD
KEY PRESSED ?
NO
YES
NUMERIC ?
YES
XMIT FLAG SET ?
YES
NO
STORE KEY IN BUFFER
ADD CHAR TO DISPLAY
RET
NO
CLEAR ?
YES
CLEAR KEY BUFFER
DISPLAY UNIT READY
CLEAR 'XMIT READY FLAG
RET
NO
ENTER ?
YES
SET 'XMIT READY FLAG
RET
NO
DIAL ?
YES
DIAL
NO
PROG ?
YES
PROG
NO
RESET ?
YES
RST
NO
START ?
YES
STRT
NO
TV/ GAME ?
YES
TOGGLE TV/ SERV. RELAY
RET
NO
PAUSE ?
NO
YES
WAIT FOR PAUSE KEY
RET
INDICATE ERROR
EXIT

FIG. 8

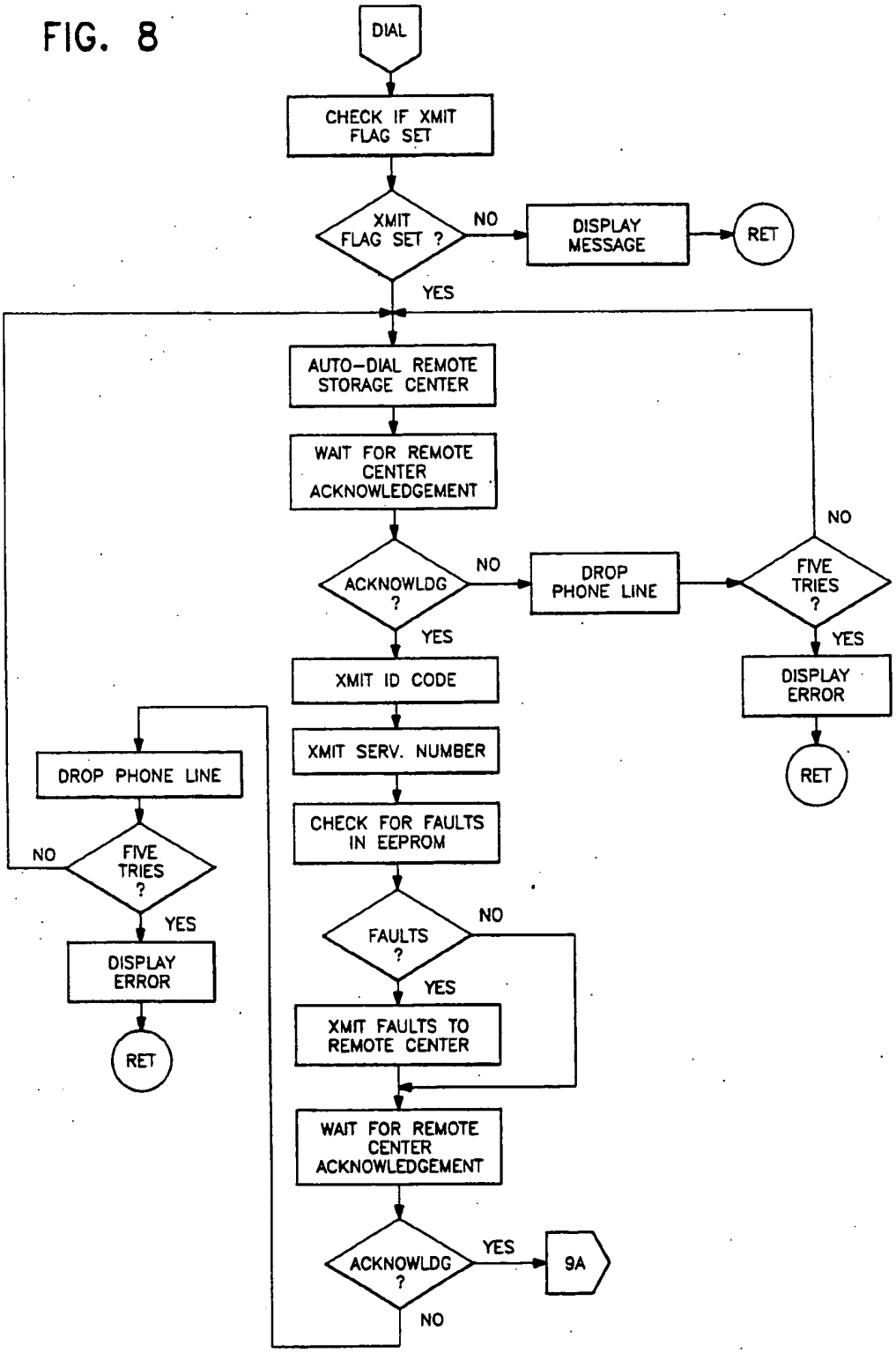

DIAL
CHECK IF XMIT FLAG SET
XMIT FLAG SET ?
NO
DISPLAY MESSAGE
RET
YES
AUTO-DIAL REMOTE STORAGE CENTER
WAIT FOR REMOTE CENTER ACKNOWLEDGEMENT
ACKNOWLDG ?
NO
DROP PHONE LINE
FIVE TRIES ?
NO
YES
DISPLAY ERROR
RET
YES
XMIT ID CODE
XMIT SERV. NUMBER
CHECK FOR FAULTS IN EEPROM
FAULTS ?
NO
YES
XMIT FAULTS TO REMOTE CENTER
WAIT FOR REMOTE CENTER ACKNOWLEDGEMENT
ACKNOWLDG ?
YES
9A
NO
DROP PHONE LINE
FIVE TRIES ?
NO
YES
DISPLAY ERROR
RET

FIG. 9

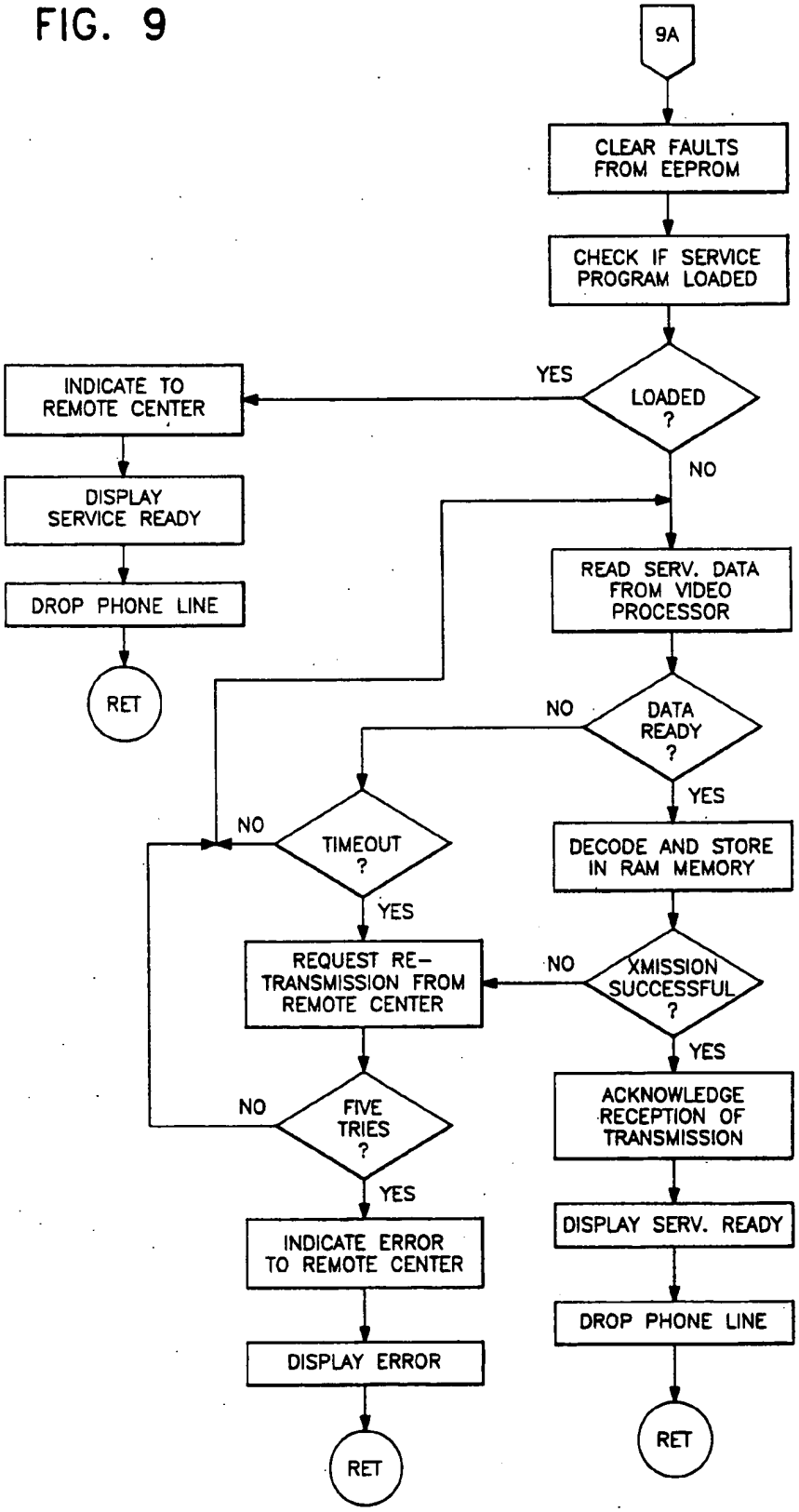

9A
CLEAR FAULTS FROM EEPROM
CHECK IF SERVICE PROGRAM LOADED
LOADED ?
YES
INDICATE TO REMOTE CENTER
DISPLAY SERVICE READY
DROP PHONE LINE
RET
NO
READ SERV. DATA FROM VIDEO PROCESSOR
DATA READY ?
NO
YES
TIMEOUT ?
NO
YES
REQUEST RE-TRANSMISSION FROM REMOTE CENTER
FIVE TRIES ?
NO
YES
INDICATE ERROR TO REMOTE CENTER
DISPLAY ERROR
RET
DECODE AND STORE IN RAM MEMORY
XMISSION SUCCESSFUL ?
NO
YES
ACKNOWLEDGE RECEPTION OF TRANSMISSION
DISPLAY SERV. READY
DROP PHONE LINE
RET

FIG. 10

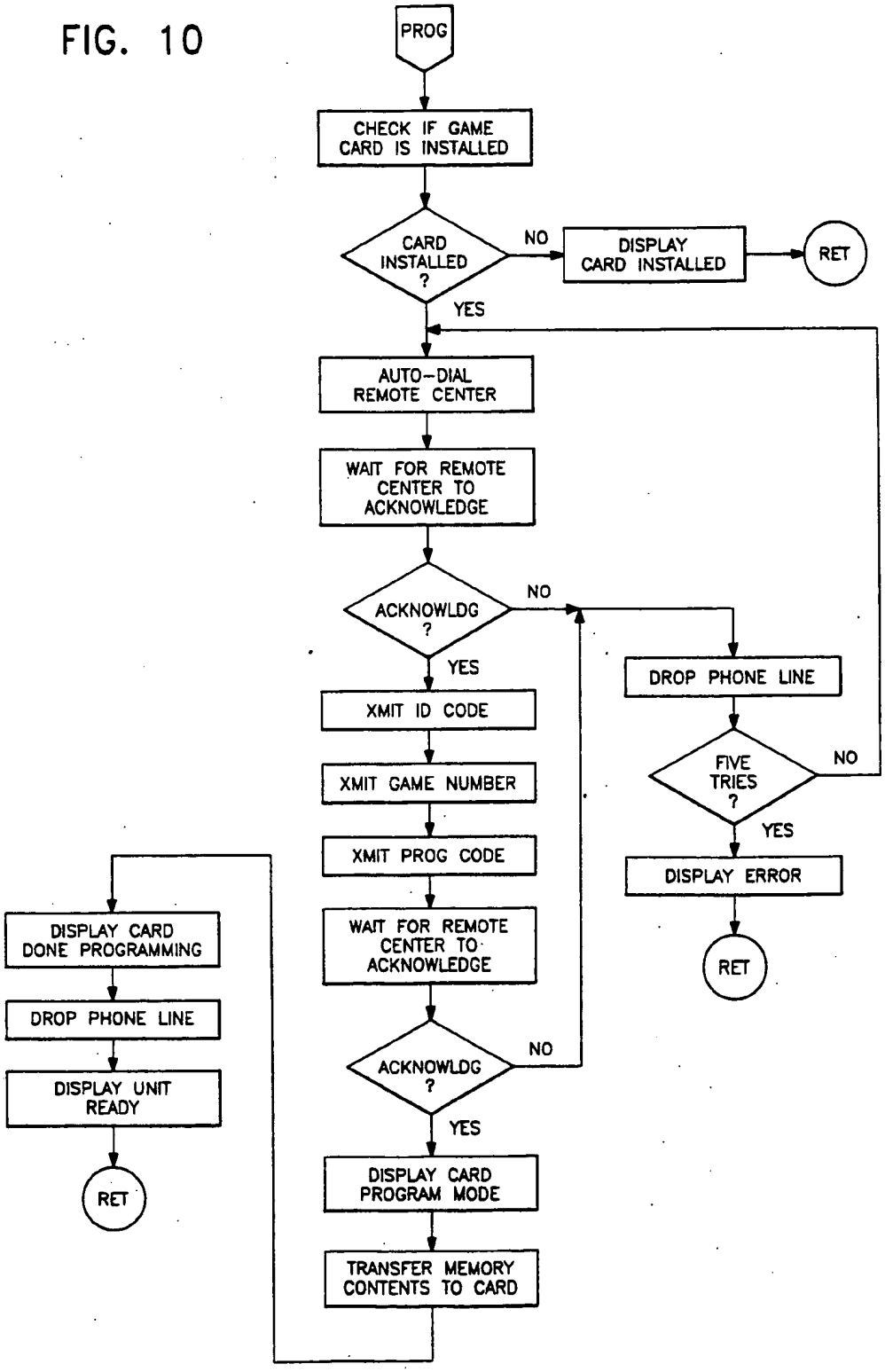

PROG
CHECK IF GAME CARD IS INSTALLED
CARD INSTALLED ?
NO
DISPLAY CARD INSTALLED
RET
YES
AUTO-DIAL REMOTE CENTER
WAIT FOR REMOTE CENTER TO ACKNOWLEDGE
ACKNOWLDG ?
NO
YES
DROP PHONE LINE
FIVE TRIES ?
NO
YES
DISPLAY ERROR
RET
XMIT ID CODE
XMIT GAME NUMBER
XMIT PROG CODE
WAIT FOR REMOTE CENTER TO ACKNOWLEDGE
ACKNOWLDG ?
NO
YES
DISPLAY CARD PROGRAM MODE
TRANSFER MEMORY CONTENTS TO CARD
DISPLAY CARD DONE PROGRAMMING
DROP PHONE LINE
DISPLAY UNIT READY
RET

FIG. 11

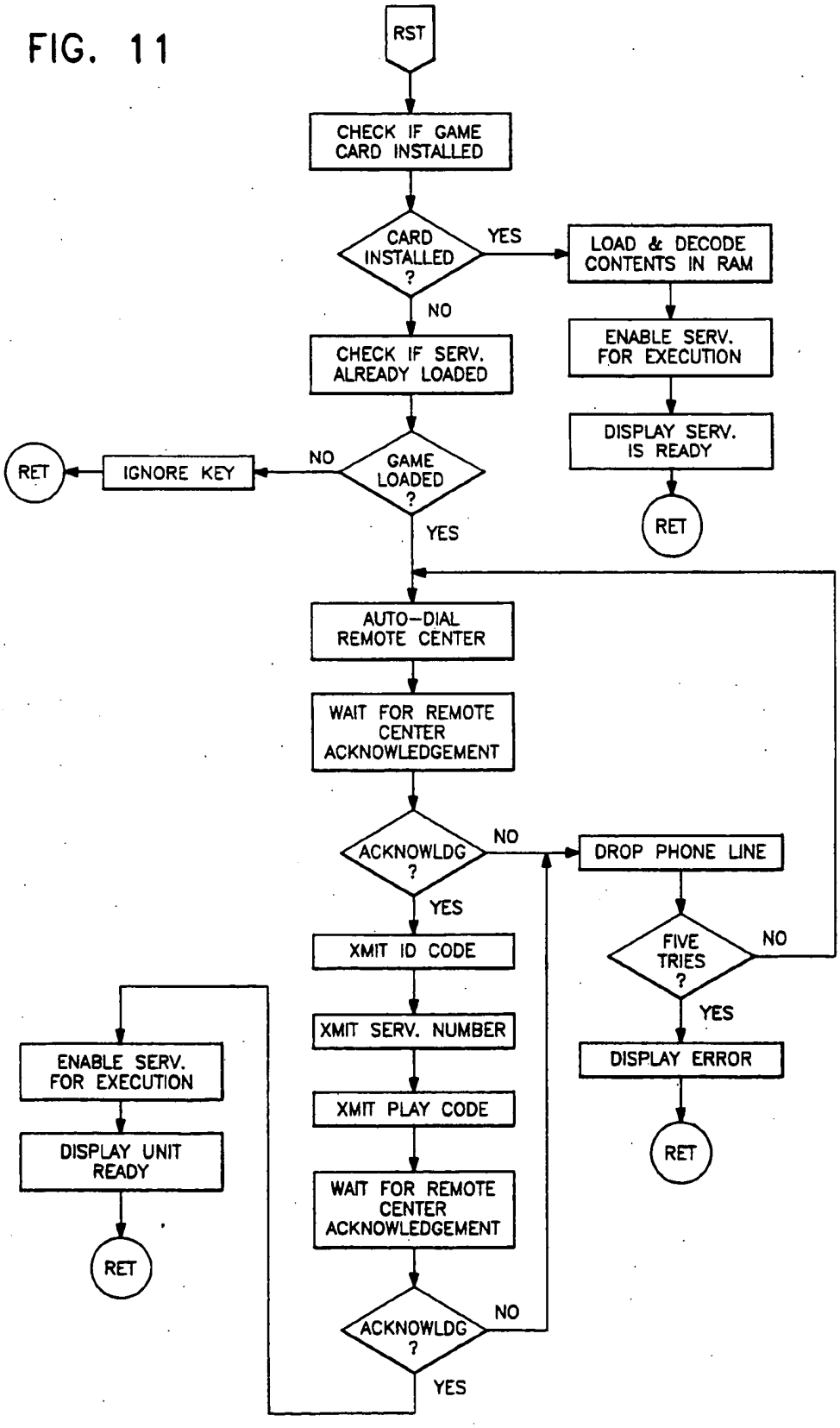
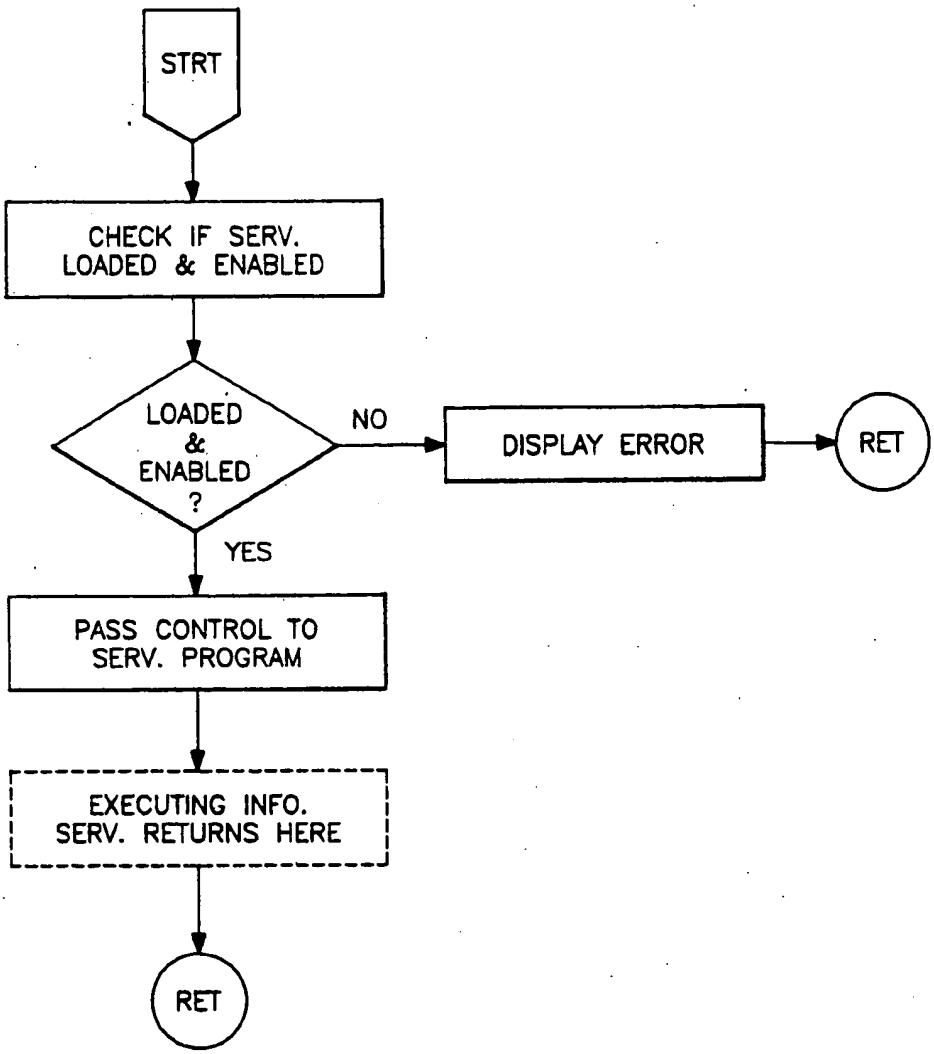

RST
CHECK IF GAME CARD INSTALLED
CARD INSTALLED ?
YES
LOAD & DECODE CONTENTS IN RAM
ENABLE SERV. FOR EXECUTION
DISPLAY SERV. IS READY
RET
NO
CHECK IF SERV. ALREADY LOADED
GAME LOADED ?
NO
IGNORE KEY
RET
YES
AUTO-DIAL REMOTE CENTER
WAIT FOR REMOTE CENTER ACKNOWLEDGEMENT
ACKNOWLDG ?
NO
DROP PHONE LINE
FIVE TRIES ?
NO
YES
DISPLAY ERROR
RET
YES
XMIT ID CODE
XMIT SERV. NUMBER
XMIT PLAY CODE
WAIT FOR REMOTE CENTER ACKNOWLEDGEMENT
ACKNOWLDG ?
NO
YES
ENABLE SERV. FOR EXECUTION
DISPLAY UNIT READY
RET

FIG. 12


STRT
CHECK IF SERV. LOADED & ENABLED
LOADED & ENABLED ?
NO
DISPLAY ERROR
RET
YES
PASS CONTROL TO SERV. PROGRAM
EXECUTING INFO. SERV. RETURNS HERE
RET

TELEPHONE ACCESS INFORMATION SERVICE DISTRIBUTION SYSTEM

This application is a continuation-in-part application of application Ser. No. 07/423,946, filed Oct. 19, 1989, now U.S. Pat. No. 5,051,822.

FIELD OF THE INVENTION

This invention relates to a home computing assembly capable of establishing a digital, interactive communications system providing a plurality of subscribers access to a variety of information services stored in a plurality of remote information services storage centers. The information services may include, for example, mall shopping services, moves as memory comes on line, personal dating services, grocery shopping service, catalog sales, classified advertising, contests and video games, with the possibility of buying a product and having it delivered to a user's home. The invention also provides for the use of a standard television receiver for video and audio, and contemporary input devices to interact with the software program, in the instances where the selected one of the variety of information services is a video game or some other interactive service. A bi-directional telephone link is established between the home computing assembly and a remote information services storage center to access the desired information service, and a cable television broadcast channel is used uni-directionally to transmit the selected information service software program as digital streams of data to the home computing assembly.

BACKGROUND OF THE INVENTION

Much is known about video gaming devices for the home. Presently, all require non-volatile game cartridges to store the game software programs, and use known color graphics circuits along with synthesized audio techniques. Game cartridges are relatively expensive to purchase, and once they are used for some time, they are used rarely thereafter. This has led to the proliferation of video game rental outlets as individuals decide that they would rather have variety than ownership, and would also rather make a shorter and less expensive commitment.

Prior art patents representing known communication or subscriber systems are represented in U.S. Pat. No. 4,829,372 to McCalley et al., wherein a digital, interactive communication system is accessible to a plurality of subscribers who can select any of a plurality of prerecorded video/audio presentations for viewing on a conventional television set. The system includes a converter tuned to a channel for monitoring a digital stream of information including digital packets representative of video/audio presentations selected by the individual subscribers. A subscriber server is housed within the apparatus supplied the individual subscriber and the subscriber server receiving uniquely addressed digital packets converts the received packets into NTSC-compatible analog formatted video/audio presentation for transmission to the requesting subscriber.

In addition, Abraham, U.S. Pat. Nos. 4,567,512 and 4,590,516, disclose a system controlled through conventional telephone networking in conjunction with a home controller that contains a micro-processor and incorporating a telephone interface which allows a subscriber to request a given program which is available on a pre-scheduled time basis. Abraham does not disclose digital transmissions.

In addition, Abraham discloses in U.S. Pat. No. 4,521,806 signal traffic paths being established for telephone communication and cable program transmission in a basic subscription broadcast system. The program material is stored at a library broadcast station in analog form and is digitized and time compressed after readout for transmission to the subscribers along the cable paths.

Other patents demonstrating the prior art of the same subject matter include U.S. Pat. No. 4,734,764 to Pocock et al., U.S. Pat. No. 4,761,684 to Clark et al., and U.S. Pat. No. 4,763,191 to Gordon et al.

In addition to the above, U.S. Pat. No. 4,584,603 to Harrison discloses an amusement and information system for use in a closed environment such as on airlines wherein an entertainment terminal including a keyboard and video display assembly is available for use by the occupant and is structured to provide access to video games as well as movies and other selected information.

Although it is well known to use a bi-directional telephone link, as evidenced by the above-noted patents, to access audio and video information that is transmitted as a related but independent television broadcast channel, it is apparent that a need exists for the transmission of executable computer software program code representing a variety of information services using a television broadcast channel to reach a plurality of subscribers and act upon individual requests.

It is an object of this invention to provide a vehicle whereby a plurality of information service software programs are made available substantially upon demand and upon request to individual subscribers on a "pay-per-use" basis with a minimum of subscriber overhead.

Another object is to provide a home computing assembly that provides the means to utilize said software programs, from within the residence and under subscriber control, and optionally using contemporary game control devices.

SUMMARY OF THE INVENTION

In accordance with the system of the present invention, any of a plurality of individual subscribers may request one of a plurality of information services stored in a software program library at a remote location utilizing a home computing element or assembly to establish a bi-directional telephone communication link with a remote information services storage center to access the services offered. The remote information services storage center acknowledges the request and establishes a bi-directional channel of communications.

The home computing element transmits a unique identification code, an information service select code, the existence of a previously loaded information service software program and any mode commands. During this time, the display on the home computing element shows the status of the operation in progress. If the home computing element cannot establish communications with the remote information services storage center, it will retry several times before dropping the line and indicating a failed communication attempt to the subscriber.

While maintaining communications with the home computing element, the remote information services storage center logs the time, telephone number, identification code, the operating mode and the desired infor-

mation service selection of the requesting home computing element. If the selected information service is already resident in the home computing element, the remote information services storage center transmits an authorization code to the home computing element effectively enabling the software program, and drops the telephone line. An information service software program is not transmitted in this case, but if the selection is not in the home computing element memory, the remote information services storage center transmits the encoded information service software program and the home computing element identification code as a digital bit stream of information over a television broadcast channel. The telephone line is maintained active until all tasks have been completed.

The home computing element requesting the information service may receive the information service software program only after identification code validation occurs. This prevents unauthorized use by others. Once reception of all the software data has been successfully completed, the home computing element acknowledges receipt to the remote information services storage center and drops the telephone line. The encoded software program is decoded and is enabled t be used. The subscriber is told through the display that the information service is ready for use. All of these actions occur in a very short period of time.

The home computing element offers the subscriber the means to interact with the information service using contemporary gaming controls or input devices, for example, for selection of services or purchases. The information service may be used as many times as desired. Each time the subscriber restarts the information service, a telephone link is established with the remote information services storage center for billing and authorization for use before the information service may be used. The software program remains in memory until either power is removed or a new software program is loaded. Even though a program may be resident within the home computing element, its use is restricted unless authorization is issued by the remote information services storage center. The remote information services storage center always maintains an activity log for each subscriber which is used for billing.

BRIEF DESCRIPTION OF THE DRAWINGS

For a fuller understanding of the nature of the present invention, reference should be had to the following detailed description taken in connection with the accompanying drawings.

FIG. 1 is a system level block diagram depicting a digital interactive communication system in conjunction with a home computing assembly of the present invention.

FIG. 2 is a front view of one preferred embodiment of the home computing assembly as represented in block diagram in FIG. 1.

FIG. 3 is a detailed functional block diagram of the home computing assembly shown in FIG. 2.

FIG. 4 is a functional block diagram of one embodiment of a remote information storage center of the present invention.

FIG. 5 is a flow chart depicting the operational logic encompassing the remote information storage center of FIG. 4.

FIG. 6 is a flow chart that relates the tasks performed by a home computing assembly executive program.

FIG. 7 is a flow chart showing the functional aspects of a command processor defined as part of the home computing assembly shown in FIG. 2.

FIG. 8 is a flow chart of the dial-up routine "DIAL" which is invoked by the command processor whose flow chart is shown in FIG. 7.

FIG. 9 is a continuation of the flow chart shown in FIG. 8.

FIG. 10 is a flow chart of the functions performed by the game storage card programming routine "PROG" which is invoked by the command processor of the home computing element whose flow chart is shown in FIG. 7.

FIG. 11 is a flow chart of the reset information service routine "RST" which is invoked by the command processor whose flow chart is shown in FIG. 7.

FIG. 12 is a flow chart of the start information service routine "STRT" which is invoked by the command processor whose flow chart is shown in FIG. 7.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, a preferred embodiment of the present invention comprises a system including a plurality of remote information storage centers 60 which communicate with a plurality of home subscriber installations. Each of the home subscriber installations includes a home computing assembly or element 10, a standard television receiver 73 and, optionally, one or more game control devices 12 for use when a video game is selected.

A digital interactive communications environment is established using a plurality of voice quality telephone lines 74 and a television broadcast facility such as a cable television (CATV) network, defined in FIG. 1 as a cable TV head end 92, which is linked to the home subscriber installations and more particularly, the home computing element 10 by cable 71. It should be noted that the telephone lines 74 directly connect the remote information storage center 60 with the home computing element 10 and also connect the remote information storage center with a headquarters 90, to be described in greater detail hereinafter.

The home subscriber utilizes the home computing element 10 to call the remote information services storage center 60 through the telephone line 74. Once a telephone link is established, the subscriber selects any one of a plurality of information services, including for example mall shopping services, personal dating services, moves as memory comes on line, grocery shopping service, catalog sales, travel agency services, floral services, classified advertising, contests, and pre-stored video games, or other software programs which have been previously offered to the subscriber in a menu format.

The service to be selected may include an interaction through the home computing element to arrange for browsing through a service, and the ability to purchase an item and arrange for delivery to a desired location. In the shopping mall service, for example, a three-dimensional, two level mall, complete with landscaping, fountains, escalators and music is displayed on a television receiver, having been downloaded from the remote information services storage center to the home computing element. By use of a joy-stick, a lifelike computer person is guided through the mall into any store to view the contents of the store and to examine products being sold.

A selection of the particular service is made by pressing the appropriate keys 24 on the home computing element 10 as set forth in greater detail in FIG. 2. The software program representing the selected information service is retrieved from a permanent storage library by a computer facility at the remote information services storage center 60 and transmitted typically to a CATV head end 92 as an encoded stream of digital data 70 in NTSC compatible format. A signal of the encoded stream of digital data is then broadcast through the CATV network along with prerecorded menu information programming to all cable subscribers. All cable subscribers may view the pre-recorded menu information programming portion. However, only the specifically requesting subscriber locations or home installations containing the requesting home computing element 10 can receive, store, decode and use the requested information software programs.

An RF video signal is received from the distribution cable 71, is processed and the resulting, decoded software program stored by the home computing element 10 is then enabled for use by the subscriber in conjunction with display at the conventional television receiver 73. The desired gaming control devices 12 are also usable for subscriber interaction with a video game software program, if selected from the information services.

All billing for use of the subscribed information services is performed automatically by the computer facilities of the remote information storage center 60 and the billing information is transmitted over the telephone lines 74 to the main office or headquarters 90 (see FIG. 1). The headquarters 90 may also request other specific information such as, but not limited to, diagnostic test results from the remote information storage center 60 and may send commands and/or software programs that may be executed by the computer facilities maintained within the remote information storage center 60.

Again with reference to FIG. 2, a preferred embodiment of the home computing element or assembly 10 encompasses an alphanumeric display 13 to demonstrate or display messages. In addition, a keyboard for subscriber interaction, for example, to enter information service selection and commands are represented and includes numerical keys 24. In addition, commands may be entered into the system during us of the home computing element 10.

In operation, the subscriber first uses the numeric keypad 15 further utilizing any of the numerical keys to enter the code number for a selected information service program from a previously provided menu. The clear key 16 is used to correct any data entry errors. Once the entire number is entered the enter key 17 is pressed and the home computing element 10 responds by displaying the selections on the display 13. The dial key 18 is then pressed to call the remote information services storage center 60 and transmit the proper home computing element 10 personal identification number (PIN) and information service selection number by virtue of telephone line 74. The appropriate information service software program is received from cable TV head end 92 by the home computing element 10 where it is decoded and stored. The display 13 indicates that an information service is loaded in the home computing element and ready for use.

Display on TV receiver 73 is started by pressing the start key 23 and paused at any time by pressing the appropriate pause key 22. Pressing pause key 72 again serves to restart the game. The TV/service key 21 ma be pressed to switch to view standard programming on the television receiver 73, overriding the information service display and audio.

In the case of a video game software program selection, the video game software program may be permanently stored in a removable, non-volatile memory card 25 by ensuring that a card is placed in the side slot as appears in FIG. 2. A one time purchase charge will be billed, but the game may be played as often as the subscriber likes using the card 25 without incurring additional costs.

FIG. 3 is a detailed, internal block diagram which shows all of the major circuits contained in the home computing element 10. The home computing element 10 is based on a microprocessing unit 30 which acts as the overall controller. The micro-computer 30 operates as dictated by the executive program which is stored in the ROM 31. The flow charts as set forth in FIGS. 5 through 12 illustrate the operations related to the executive program in more specific detail.

Data areas required by the executive and external program areas reserved for the use of downloaded information services software programs reside in random access memory (RAM) 32. The memory areas in RAM are volatile and will lose their contents if power is removed, therefore, an electrically erasable programmable read only memory (EEPROM) 33 provides non-volatile storage for such data as the telephone number of the remote information storage center 60 serving the subscriber, the home computing element 10 identification code, and other information that must be retained if power is lost.

As shown in FIG. 3, several circuits are provided to interface the micro-controller or micro-processor unit 30 to the outside world referred to herein as peripheral devices. A telephone link is provided by a universal asynchronous receiver/transmitter (UART) 34 whose digital output keys two distinct audio tones that are transmitted to the telephone line, along with "handshaking" information by a modem interface 35. The modulated outputs are transformer coupled to the telephone line 74. All telephone communications, including automatic dial-up are handled by the micro-processing unit 30 utilizing this circuitry.

The keyboard 42 status is read by the micro-processing unit 30 through a peripheral interface adapter 40 which is capable of interfacing with digital inputs and outputs only. A contact based control adapter is interfaced to the micro-processing unit 30 through the peripheral interface adapter 40, but potentiometer based input devices, such as some joy-sticks and trackballs, if a video game information service is selected, are interfaced through an analog to digital convertor (ADC) 39 which is capable of converting the analog signals provided by the input device to their numeric or binary representations required by the micro-processing unit 30. The display module 13 (see also FIG. 2) containing the internal electronics necessary to display alpha/numeric characters, interfaces directly to the micro-processing unit 30 data bus 50. The display is where all the system status messages are displayed to the subscriber.

Again with reference to FIG. 3, the incoming broadcast channel 71 is monitored for information service software programs. The signal is demodulated by an RF demodulator 36 and then passed to a digital signal processor 37 which samples the signal, converts it to digital data, processes the information and then makes it avail-

able to the micro-processing unit 30. The digital signal processor 37 is a single-chip computer tailored to the task of obtaining a digital representation of analog signals and digital processing at a very fast rate; currently up to 33 million operations per second. The digital signal processor 37 acts as a co-processor operating under the control of its own custom software program written in a machine specific computer language.

The NTSC compatible signal 52 that is ultimately connected to the television receiver 73 contains all of the video and audio information associated with the selected information service. The video is generated by the graphics generator circuit 45 which is itself another co-processor, while the sound generator 44 creates all of the audio and is directly controlled by the micro-processing unit 30. The output signals ar used to modulate carriers with the video 47 and audio 46 modulators and then mixed with an RFT combiner 48 whose output is an NTSC compatible television signal 52 that drives the television receiver 73. The TV/SERVICE relay 49 is controlled by the micro-processing unit 30 and connects the output of the combiner 52 to the video output jack. The relay 49 responds to the activity of the TV/SERVICE key 21 as an alternate action device.

With reference to FIG. 4, the remote information storage center 60 (FIG. 1) includes a thirty-two bit desk top computer 61 to perform all required processing, storage and control functions. Storage for the dedicated and information service software is provided by a hard disk 63 with fast access times. The computer 61 is initially loaded from the magnetic tape cartridge drive 64 by a utility invoked from the 1.44 megabyte floppy drive 62 containing the appropriate disk. The utility reads the software programs from the tape drive 64 and stores it on the hard disk 63 for fast, random access of files. The flow chart illustrating the major tasks performed by the executive program of the remote information services storage center 60 is shown in FIG. 5.

The computer 61 is also responsible for controlling telephone access to resident services. A plurality of telephone lines 79 are routed by a telephone switching controller 67 to several modems 66 which convert the FSK telephone signals 80 to RS-232 digital, serial data 81. This data is read and buffered by a RS-232 multiplexer/buffer 65 which allows high speed data transfers through a parallel interface 87 to serve a large plurality of modems 66. These are all bi-directional data paths allowing the computer 61 to receive and transmit data through the telephone. The computer 61 responds to different messages from the subscriber and other messages from the main office or headquarters dealing with information service selections to be broadcast, types of service being provided, diagnostic test results, and billing information and other relevant information requests or command messages.

The last major task performed by the remote information storage center 60 computer 61 is the transmission of the information service software programs that will ultimately be executed in a home computing element 10. The software is output by the computer 61 as a digital bit stream 85 which is modulated and mixed with the signal coming from the video cassette recorder/player (VCR) 68, or other broadcast source by an RF modulator 69. The resulting output 70 is then typically delivered to a CATV head end 92 for distribution. The VCR 68 contains standard pre-recorded programming for broadcast such as an information services menu, and is controlled by the computer 61 through a series of control lines 83.

It is therefore to be understood that the following claims are intended to cover all the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

I claim:

1. A bi-directional, interactive communications system for transmitting in a digital format, information services to a plurality of subscriber locations on demand, said bi-directional communications system comprising:

a remote information services storage center for storing a variety of information service programs,

a television broadcast facility for uni-directionally transmitting a selected one of said variety of information service programs,

a home computing assembly disposed at each subscriber location and connected bi-directionally by telephone lines to the remote information services storage center and also being linked to the television broadcast facility,

a television receiver connected to said home computing assembly, .

said home computing assembly being structured to receive an individually addressed code from the remote information services storage center and to cause transfer of digital streams of data from the remote information services storage center to the television broadcast facility and transfer of the digital streams of data from the television broadcast facility to said home computing assembly for storage by said home computing assembly upon comparison and matching of an identification code of said home computing assembly with said individually addressed code as received from said remote information services storage center, and

said home computing assembly including decoder means tuned to a television broadcast channel of said television receiver for monitoring the digital streams of data as transmitted from the television broadcast facility,

said home computing assembly including digital processing means for receiving the digital streams of data by the requesting one of home computing assemblies, and

said home computing assembly further including distributed computer processing means for invoking the selected one of said variety of information service programs to perform a task associated with the selected one of said variety of information service programs and means to interact with the selected one of said variety of information service programs as received from the television broadcast facility.

2. A system as claimed in claim 1, wherein each of said home computing assemblies are defined as remote slave computers within a wide area network.

3. A system as claimed in claim 1, wherein each of said home computing assemblies include independent control of video and audio of said television receiver.

4. A system as claimed in claim 1, wherein each of said home computing assemblies include a memory programmer means for permanently recording said selected one of said variety of information services in RAM memory on a programmable memory medium.

5. A system as claimed in claim 1, wherein said remote information storage center includes a self-test diagnostic capability means for allowing access to a fault history map used to isolate malfunctions of one of system, components, telephone links and television broadcast channels.

6. A system as claimed in claim 1, further comprising a computer based adaptive billing sub-system for tracking subscriber activity.

7. A bi-directional, interactive communications system for transmitting in a digital format, information services to a plurality of subscriber locations, said bi-directional interactive communications system comprising:

a remote information services storage center for storing a variety of information services,

a television broadcast facility for uni-directionally transmitting a selected one of said variety of information services,

a home computing assembly disposed at each subscriber location and connected bi-directionally by telephone lines to the remote information services storage center and also being linked to the television broadcast facility,

a television receiver connected to said home computer assembly,

said home computing assembly communicating bi-directionally over telephone lines with the remote information services storage center to cause said selected one of said variety of information services to be transferred as digital streams of data with an individually addressed code from the remote storage center to the television broadcast facility and transferred as said digital streams of data from the television broadcast facility to said home computing assembly for storage by said home computing assembly upon comparison and matching of an identification code of said home computing assembly with said individually addressed code as received from said information services storage center,

said home computing assembly including storage means for storing said digital streams of data as transmitted from the television broadcast facility,

said home computing assembly further including digital processing means for processing said digital streams of data stored by the storage means and displaying said selected one of said variety of information services on said television when desired.

8. A system as claimed in claim 7, wherein each of said home computing assemblies are defined as remote slave computers within a wide area network.

9. A system as claimed in claim 7, wherein each of said home computing assemblies include independent control of video and audio of said television receiver.

10. A system as claimed in claim 7, wherein each of said home computing assemblies include a memory programmer means for permanently recording said selected one of said variety of information services in RAM memory on a programmable memory medium.

11. A system as claimed in claim 7, wherein said remote information storage center includes a self-test diagnostic capability means for allowing access to a fault history map used to isolate malfunctions of one of system, components, telephone links and television broadcast channels.

12. A system as claimed in claim 7, further comprising a computer based adaptive billing sub-system for tracking subscriber activity.

13. A bi-directional, interactive communications system for transmitting in a digital format, information services to a plurality of subscriber locations on demand, said bi-directional communications system comprising:

a remote information services storage center for storing a variety of information service programs,

a television broadcast facility for uni-directionally transmitting a selected one of said variety of information service programs,

a home computing assembly disposed at each subscriber location and connected bi-directionally by telephone lines to the remote information services storage center, and also being linked to the television broadcast facility,

a television receiver connected to said home computing assembly,

said home computing assembly being structured to receive an individually addressed code over telephone lines to the remote information services storage center and to cause transfer of digital streams of data from the remote information services storage center to the television broadcast facility and transfer of the digital streams of data from the television broadcast facility to said home computing assembly for storage by said home computing assembly upon comparison and matching of an identification code of said home computing assembly with said individually addressed code as received from said remote information services storage center, and said home computing assembly including decoder means tuned to a television broadcast channel of said television receiver for monitoring the digital streams of data as transmitted from the television broadcast facility,

said home computing assembly including digital processing means for receiving the digital streams of data by the requested one of home computing assemblies, and

said home computing assembly further including distributed computer processing means for invoking the selected one of said variety of information service programs to perform a task associated with one of said variety of information service programs and means to interact with one of said variety of information service programs as received from the television broadcast facility.

14. A system as claimed in claim 13, wherein each of said home computing assemblies are defined as remote slave computers within a wide area network.

15. A system as claimed in claim 13, wherein each of said home computing assemblies include independent control of video and audio of said television receiver.

16. A system as claimed in claim 13, wherein each of said home computing assemblies include a memory programmer means for permanently recording said selected one of said variety of information services in RAM memory on a programmable memory medium.

17. A system as claimed in claim 13, wherein said remote information storage center includes a self-test diagnostic capability means for allowing access to a fault history map used to isolate malfunctions of one of system, components, telephone links and television broadcast channels.

18. A system as claimed in claim 13, further comprising a computer based adaptive billing sub-system for tracking subscriber activity.

19. A bi-directional, interactive communications system for transmitting in a digital format, information services to a plurality of subscriber locations on demand, said bi-directional communications system comprising:

a remote information services storage center for storing a variety of information service programs,

a television broadcast facility for uni-directionally transmitting a selected one of said variety of information service programs,

a home computing assembly disposed at each subscriber location and connected bi-directionally by telephone lines to the remote information services storage center and also being linked to the television broadcast facility,

a television receiver connected to said home computing assembly,

said home computing assembly being structured to request over telephone lines one of said variety of information services from said remote information services storage center by transmission of an identification code, an information service select code, verification of existence of a previously loaded information service software, and any mode commands from said home computing assembly, and in response the remote information services storage center determines if the selected information service is already resident in the home computing assembly, and if so, transmits an authorization code to the home computing assembly to enable the previously loaded service software, and if not, the remote information services storage center transmits digital streams of data from the remote information services storage center to the television broadcast facility and transfers the digital streams of data from the television broadcast facility to said home computing assembly for storage by said home computing assembly upon comparison and matching of an identification code of said home computing assembly with an individually addressed code transmitted from said remote information services storage center, and said home computing assembly including decoder means tuned to a television broadcast channel of said television receiver for monitoring the digital streams of data as transmitted from the television broadcast facility,

said home computing assembly including digital processing means for receiving the digital streams of data by the requested one of home computing assemblies, and

said home computing assembly further including distributed computer processing means for invoking the selected one of said variety of information service programs to perform a task associated with one of said variety of information service programs and means to interact with one of said variety of information service programs as received from the television broadcast facility.

20. A bi-directional, interactive communications system for transmitting in a digital format, information services to a plurality of subscriber locations on demand, said bi-directional communications system comprising:

a remote information services storage center for storing a mall shopping service program,

a television broadcast facility for uni-directionally transmitting the mall shopping service program,

a home computing assembly disposed at each subscriber location and connected bi-directionally by telephone liens to the remote information services storage center and also being linked to the television broadcast facility,

a television receiver connected to said home computing assembly,

said home computing assembly being structured to receive an individually addressed code form the remote information services storage center and to cause transfer of digital streams of data from the remote information services storage center to the television broadcast facility and transfer of the digital streams of data of the television broadcast facility to said home computing assembly for storage by said home computing assembly upon comparison and matching of an identification code of sd home computing assembly with said individually addressed code as received form said remote information services storage center, and

said home computing assembly including decoder means tuned to a television broadcast channel of said television receiver for monitoring the digital streams of data as transmitted from the television broadcast facility,

said home computing assembly including digital processing means for receiving the digital streams of data by the requesting one of home computing assemblies, and

said home computing assembly further including distributed computer processing means for invoking the mall shopping service program and to perform a task associated with the mall shopping service program and means to interact with the mall shopping service program as received from the television broadcast facility.

* * * * *

US005270809A

United States Patent [19]

Gammie et al.

[11] Patent Number: 5,270,809

[45] Date of Patent: Dec. 14, 1993

[54] **DATA RETURN FOR A TELEVISION TRANSMISSION SYSTEM**

[75] Inventors: **Keith Gammie; Wayne Sheldrick; Arthur Woo, all of Ontario; Cameron Bates, Toronto, all of Canada**

[73] Assignee: **Scientific-Atlanta, Atlanta, Ga.**

[21] Appl. No.: **677,689**

[22] Filed: **Mar. 29, 1991**

[51] **Int. Cl.**[5] **H04N 07/00**

[52] **U.S. Cl.** **358/84**; 455/2; 379/92

[58] **Field of Search** 455/2, 4.1, 4.2, 5.1, 455/6.1; 358/84, 86; 370/95.2; 379/92

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5,012,510	4/1991	Schaubs	379/92
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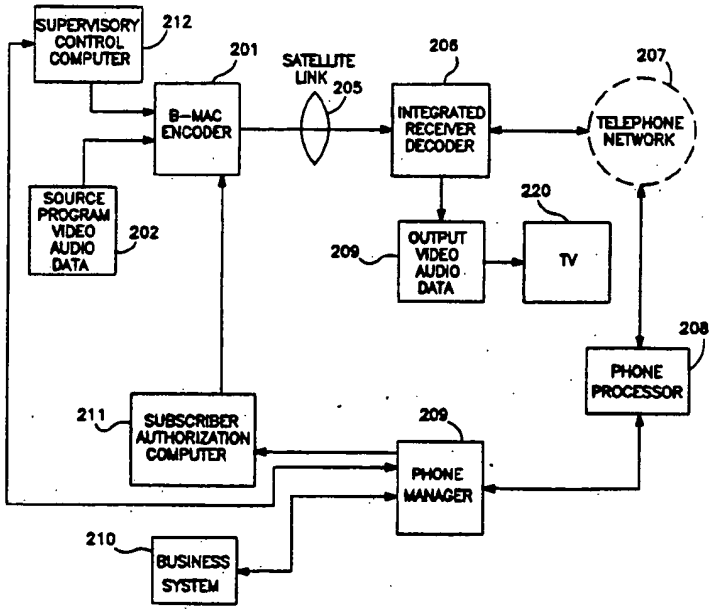
Primary Examiner—Reinhard J. Eisenzopf
Assistant Examiner—Philip J. Sobutka
Attorney, Agent, or Firm—Banner, Birch, McKie & Beckett

[57] **ABSTRACT**

A method for transmitting information over a communication network between a population of remote terminals and a central location having a capacity of simultaneously communicating with a predetermined number of remote terminals in the population. A first time period is fixed during which every remote terminal may initiate one attempt to communicate with the central location over the communication network. Respective times within the first time period are established at which each of the remote terminals will initiate its attempt to communicate with the central location. A number of the remote terminals which successfully communicate with the central location to transmit information therebetween is monitored. The first time period is then decreased to a second time period if the number of remote terminals which successfully communicate with the central location is less than the capacity of the central location. Respective times within the second time period are then established at which remote terminals which have not initiated their respective attempts to communicate with the central location will initiate their attempts to communicate with the central location. The above steps are repeated to establish a time period at which the number of remote terminals which communicate with the central location is approximately equal to the capacity of the central location. The time period thus set is maintained until each of the remote terminals has initiated its attempt to communicate with the central location.

15 Claims, 6 Drawing Sheets



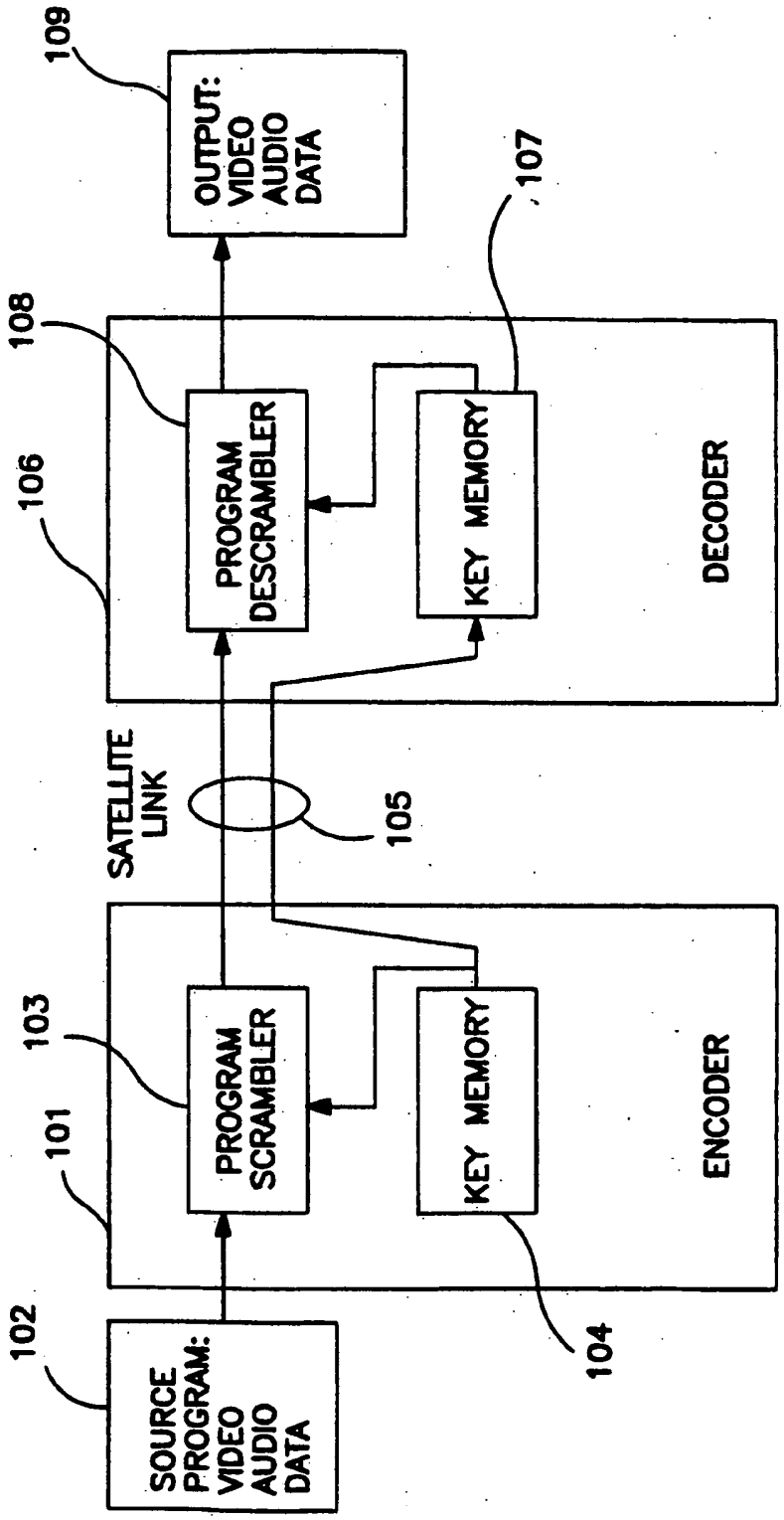


FIG. 1 PRIOR ART

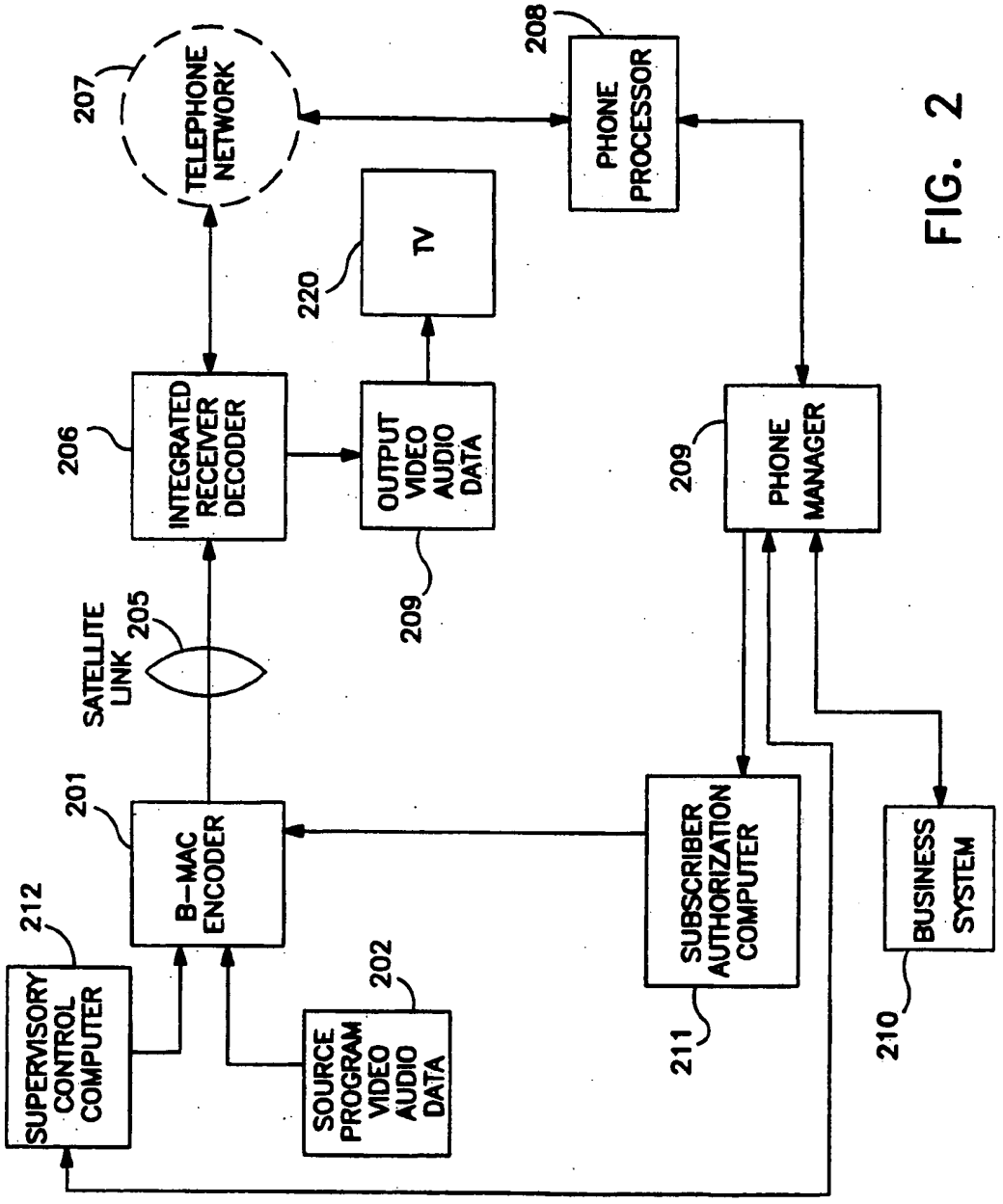

TELEPHONE NETWORK
207
PHONE PROCESSOR
208
TV
220
INTEGRATED RECEIVER DECODER
206
OUTPUT VIDEO AUDIO DATA
209
PHONE MANAGER
209
SATELLITE LINK
205
B-MAC ENCODER
201
SUBSCRIBER AUTHORIZATION COMPUTER
211
BUSINESS SYSTEM
210
SUPERVISORY CONTROL COMPUTER
212
SOURCE PROGRAM VIDEO AUDIO DATA
202

FIG. 2

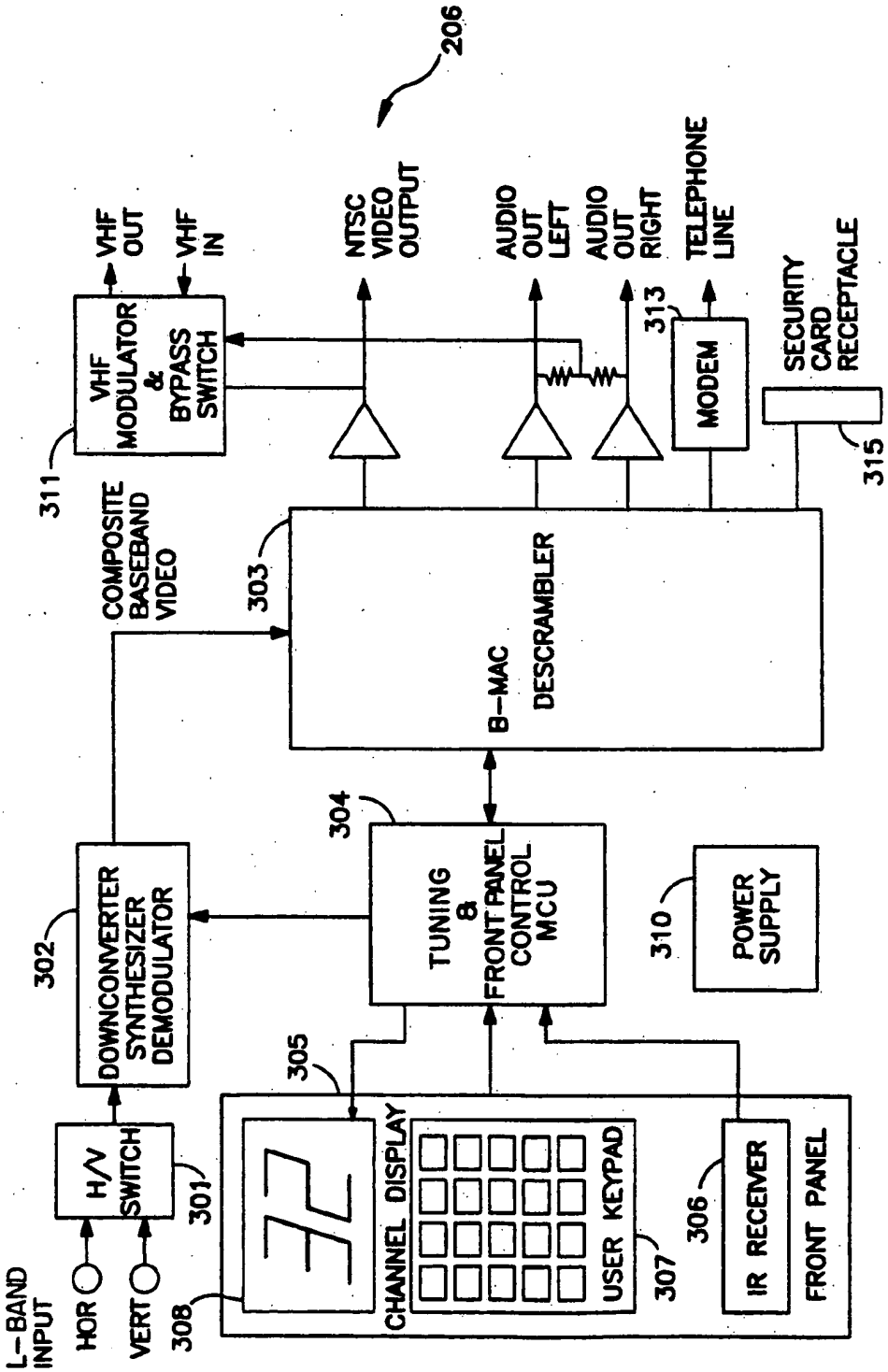
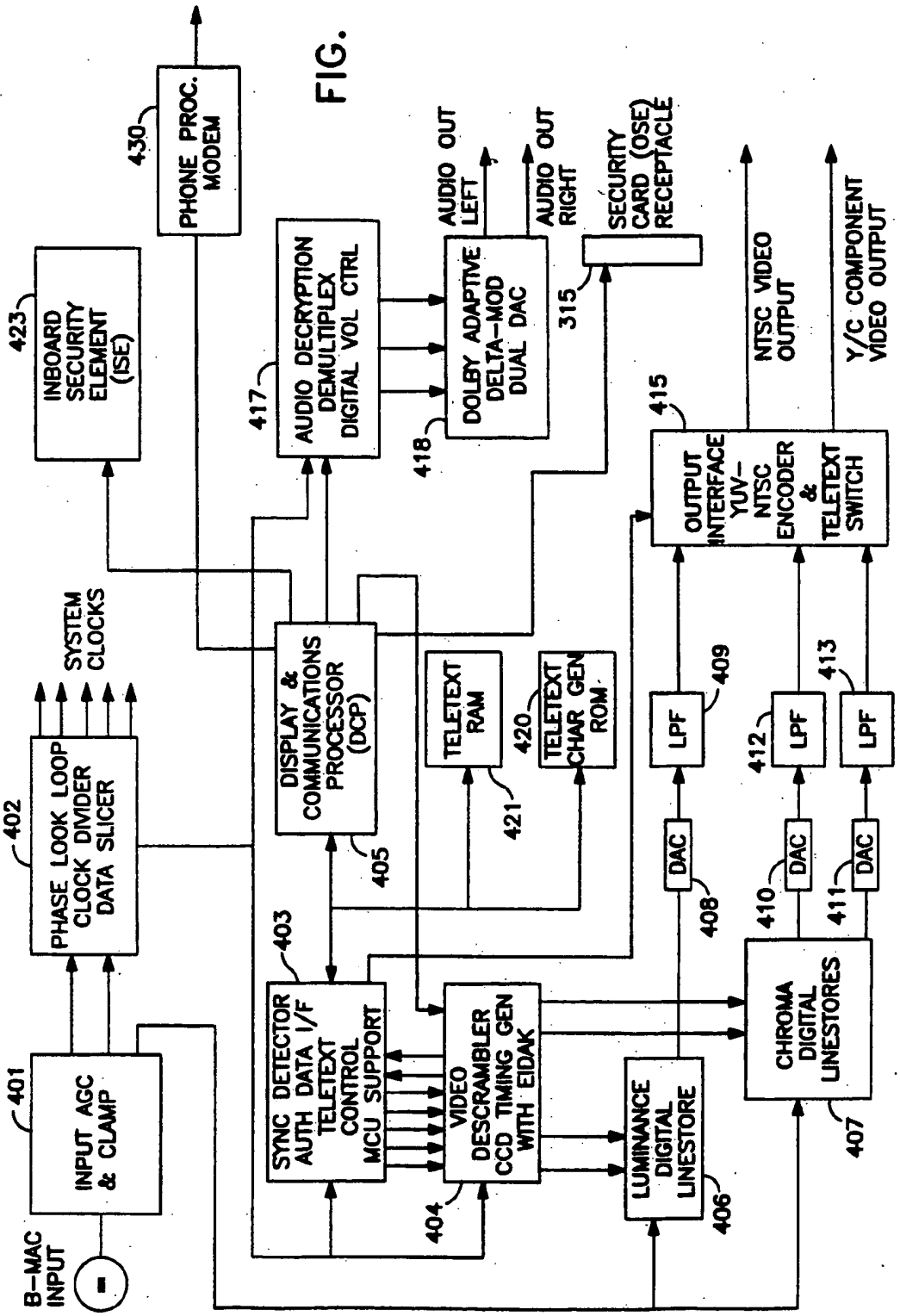

206
VHF OUT
VHF IN
NTSC VIDEO OUTPUT
AUDIO OUT LEFT
AUDIO OUT RIGHT
TELEPHONE LINE
SECURITY CARD RECEPTACLE
VHF MODULATOR & BYPASS SWITCH
311
313
MODEM
315
COMPOSITE BASEBAND VIDEO
303
B-MAC DESCRAMBLER
304
TUNING & FRONT PANEL CONTROL MCU
302
DOWNCONVERTER SYNTHESIZER DEMODULATOR
310
POWER SUPPLY
305
H/V SWITCH
301
CHANNEL DISPLAY
USER KEYPAD
307
306
IR RECEIVER
FRONT PANEL
L-BAND INPUT
HOR
VERT
308

FIG. 3

FIG. 4


B-MAC INPUT
INPUT AGC & CLAMP
401
PHASE LOOK LOOP CLOCK DIVIDER DATA SLICER
402
SYSTEM CLOCKS
SYNC DETECTOR AUTH DATA I/F TELETEXT CONTROL MCU SUPPORT
403
VIDEO DESCRAMBLER CCD TIMING GEN WITH EIDAK
404
DISPLAY & COMMUNICATIONS PROCESSOR (DCP)
405
LUMINANCE DIGITAL LINESTORE
406
CHROMA DIGITAL LINESTORES
407
DAC
408
LPF
409
DAC
410
DAC
411
LPF
412
LPF
413
TELETEXT RAM
421
TELETEXT CHAR GEN ROM
420
OUTPUT INTERFACE YUV-NTSC ENCODER & TELETEXT SWITCH
415
NTSC VIDEO OUTPUT
Y/C COMPONENT VIDEO OUTPUT
SECURITY CARD (OSE) RECEPTACLE
315
AUDIO OUT LEFT
AUDIO OUT RIGHT
DOLBY ADAPTIVE DELTA-MOD DUAL DAC
418
AUDIO DECRYPTION DEMULTIPLEX DIGITAL VOL CTRL
417
INBOARD SECURITY ELEMENT (ISE)
423
PHONE PROC. MODEM
430

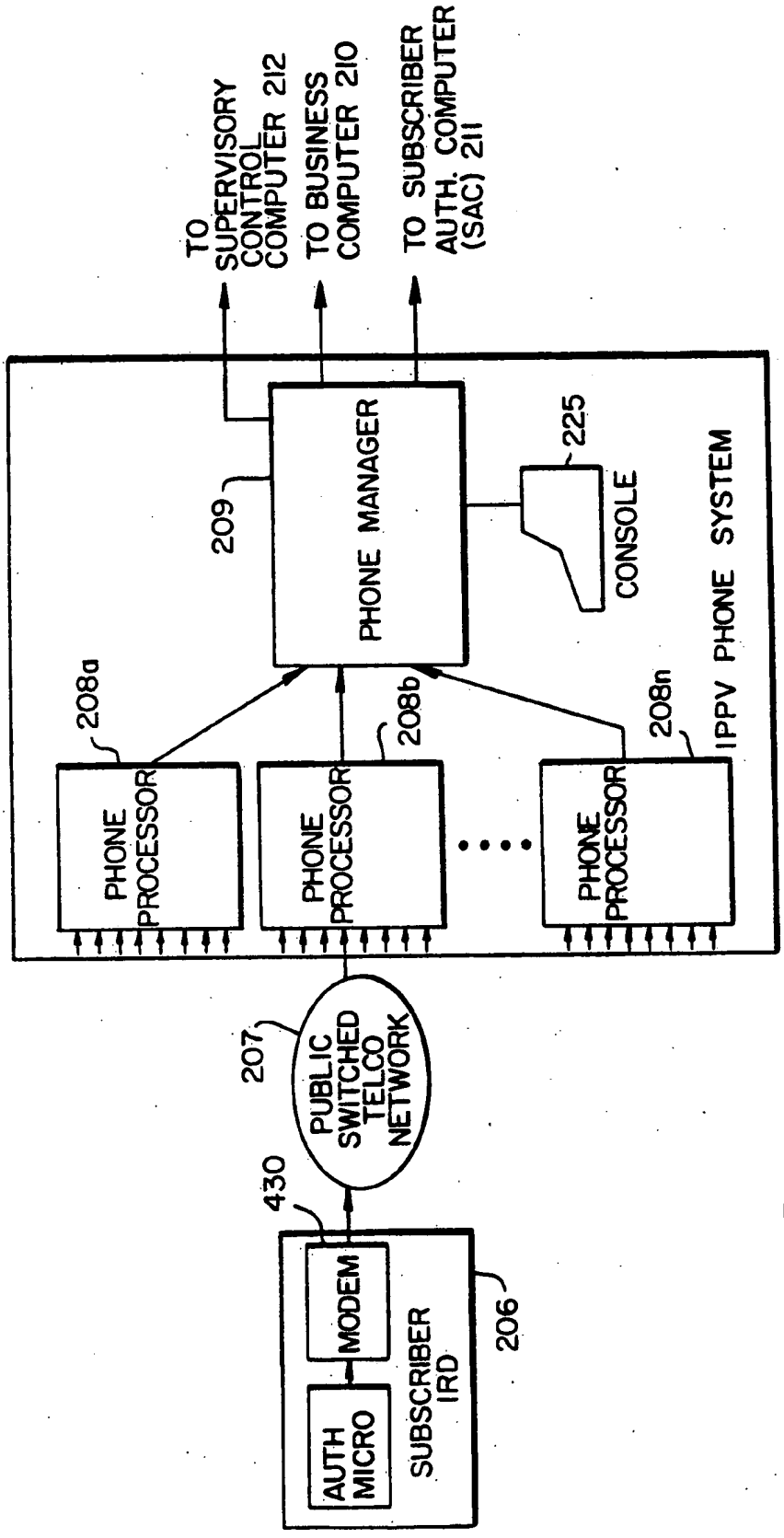

TO SUPERVISORY CONTROL COMPUTER 212
TO BUSINESS COMPUTER 210
TO SUBSCRIBER AUTH. COMPUTER (SAC) 211
209
PHONE MANAGER
225
CONSOLE
IPPV PHONE SYSTEM
208a
208b
208n
PHONE PROCESSOR
PHONE PROCESSOR
PHONE PROCESSOR
207
PUBLIC SWITCHED TELCO NETWORK
430
MODEM
AUTH MICRO
SUBSCRIBER IRD
206

FIG. 5

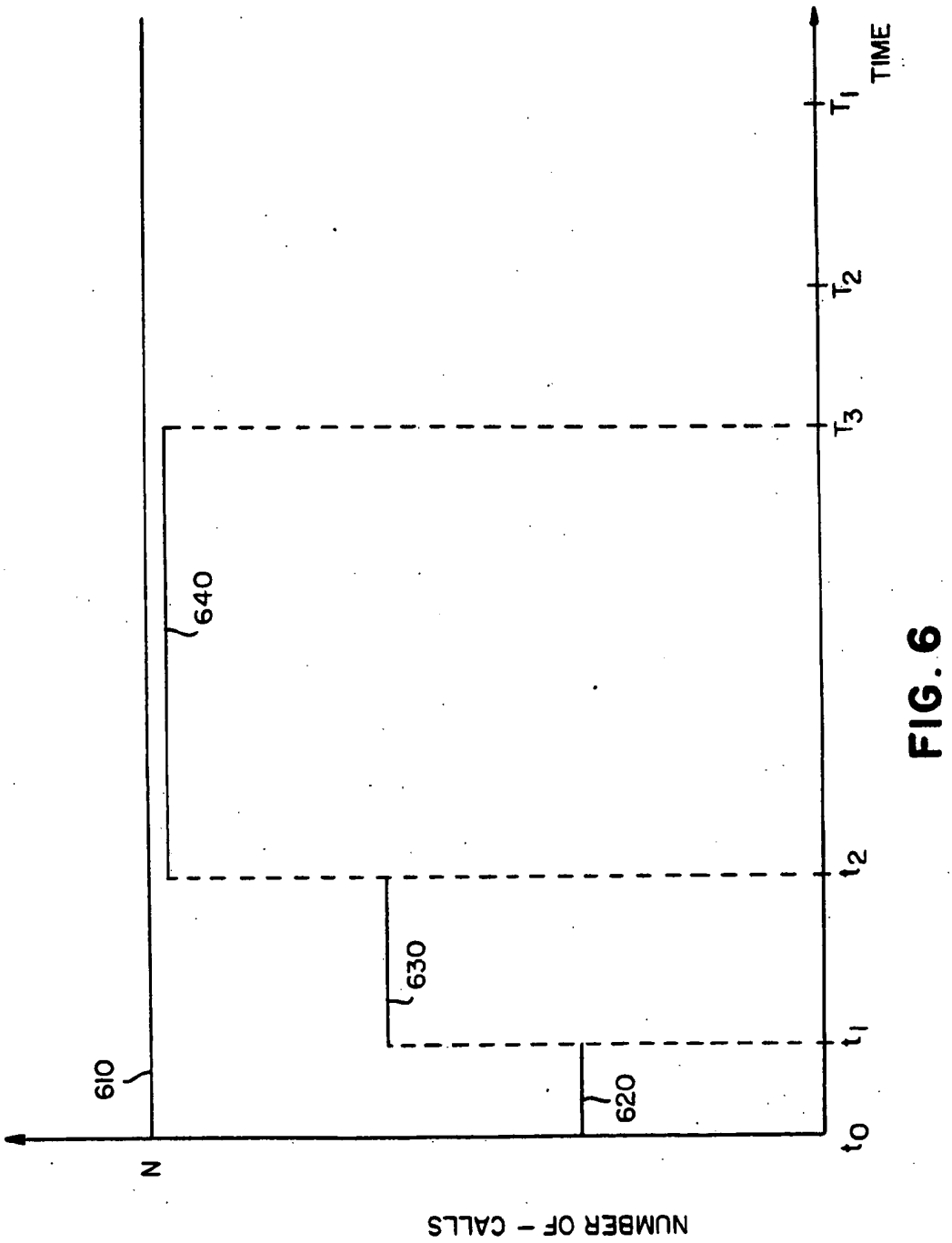


FIG. 6

DATA RETURN FOR A TELEVISION TRANSMISSION SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention generally relates to a method and a system for establishing communication between a plurality of remote units and a central location in a television transmission system and, more particularly, to a method and apparatus for transferring information such as billing information and viewing statistics from decoder units to a central location in a satellite television transmission system.

2. Description of the Relevant Art

For the purposes of the following discussion and this invention, the term "subscriber" means one who receives a television service. The "subscriber" could thus be an individual consumer with a decoder in his own home, or could be a system operator such as a local cable TV operator, or a small network operator such as a hotel/motel operator with a central decoder for all televisions in the hotel or motel. In addition, the "subscriber" could be an industrial user, as described in U.S. Pat. No. 4,866,770 assigned to the same assignee as the present application and incorporated herein by reference.

For the purposes of this invention, a network is defined as a program source (such as a pay television provider), an encoder (sometimes called a "head end"), a transmission means (satellite, cable, radio wave, etc.) and a series of decoders used by the subscribers. A system is defined as a program source, an encoder, a transmission means, and a single receiving decoder. The system model is used to describe how an individual decoder in a network interacts with the encoder.

FIG. 1 shows a prior art conditional-access system for satellite transmission. In encoder **101**, the source program information **102** which comprises video signals, audio signals, and data is scrambled in program scrambler **103** using a key from key memory **104**. The scrambling techniques used may be any such techniques which are well known in the art. The key can be a signal or code number used in the scrambling process which is also required to "unlock" or descramble the program in program descrambler **108** in decoder **106**. In practice, one key can be used (single layer encryption) or more than one key (not shown). The key is usually changed with time (i.e.—monthly) to discourage piracy. The scrambled programs and the key are transmitted through satellite link **105**, and received by conditional-access decoder **106**. Decoder **106** recovers the key from the received signal, stores it in key memory **107** and applies it to program descrambler **108** which descrambles the scrambled program received over satellite link **105**, and outputs unscrambled program **109**.

Specific details of the features of a prior art conditional access system may be found in commonly assigned U.S. Pat. No. 4,890,319, incorporated herein by reference.

Such a system may allow for pay-per-view (PPV) and/or impulse pay-per-view (IPPV) programming. Pay-per-view programming is defined here as any programming where the subscriber can request authorization to watch a particular program. In many pay television systems, pay-per-view programming is used for sporting events (boxing, wrestling, etc.) or concerts which are not transmitted on a regular basis. A subscriber wishing to view the event must receive authorization in the form of a special descrambler mechanism, or in the form of a special code transmitted or input to the subscriber's decoder. A subscriber may, for example, receive authorization by telephoning a representative of the system operator who authorizes the subscriber by transmitting the special code to the subscriber's decoder.

Impulse pay-per-view programming is one type of pay-per-view programming. Impulse pay-per-view is a particularly attractive feature since it allows a subscriber to authorize his or her decoder to view pay-per-view programming without requiring the immediate intervention of the system operator. For example, the subscriber may control his decoder to permit viewing of a particular program by means of keypad sequence for effecting authorization. Billing information including, for example, a program ID and the time and date of purchase, is then stored in non-volatile memory of the decoder. Periodically, this billing information is transferred, for example over the public switched telephone network, to a billing computer of the system operator. The subscriber is then billed on a regular basis, e.g. monthly, for his or her purchases.

Since the billing information represents revenue to the system operator, it is important that this information be transferred in an efficient manner over a reasonable time period. The prior art contains a number of techniques for controlling the transfer of data from a plurality of remote terminals to a central location.

U.S. Pat. Nos. 4,241,237 and 4,455,453 to Paraskevakos et al. disclose remote meter reading systems where each of a number of remote units initiate callback at predetermined intervals to a central facility for billing and monitoring purposes. A central complex provides a digital instruction to each remote unit upon the completion of its data transfer. The instruction includes data to control the next scheduled callback time.

U.S. Pat. No. 4,584,602 to Nakagawa discloses a data collecting system and method which are capable of collecting television audience rating data. A marker signal initiates the callback and after waiting a predetermined time necessary for other terminal units to transmit their data, each terminal unit automatically dials a predetermined telephone number in order to transmit requested viewing data.

U.S. Pat. No. 4,696,029 to Cohen controls the initiation of voting calls through regulation of the visual stimuli which trigger the calls. A control center monitors polling call traffic at a plurality of central offices until it determines that the traffic being generated has reached a level which is not within the traffic-handling capability of the central office switching machines. The control center then sends messages which cause character generators at local affiliates to reduce the frequency and/or duration of the visual stimuli until the traffic generated has dropped to a level which is within the traffic handling capabilities of the central office.

U.S. Pat. No. 4,528,663 to Citta discloses a subscriber upstream communication technique for use in two-way CATV system. In accordance with the technique, the transmission window size is initially increased until a maximum window length is achieved and then the window size is decreased in response to a selected number of further transmission attempts. The transmission window is decreasing in size following the peak load to enhance the overall speed of the system.

PCT 89/10670 of Naddor et al., assigned to the assignee of the present application, discloses a callback technique in which a callback period is dynamically adjusted to promote efficient use of the telephone network. An initial guess is made to determine an initial callback period. Based on the number of calls received at the cable television headend, the length of the callback period is dynamically increased and/or decreased to control the callback rate.

While these and other systems are effective to varying degrees, they become less effective where the decoders are part of television systems servicing large geographical areas, e.g., the United States. For example, a satellite television system may include up to two million decoders. The need remains for a technique for establishing communication with such decoders in an efficient manner to, for example, gather billing information therefrom.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide a method for transferring information between a plurality of remote terminals disposed over a large geographic area and a central location.

It is another object of the present invention to provide a method of recovering billing information in an impulse pay-per-view satellite system.

In accordance with the present invention, a method for transmitting information over a communication network between a population of remote terminals and a central location having a capacity of simultaneously communicating with a predetermined number of remote terminals in the population is provided. A first time period is fixed during which every remote terminal could initiate one attempt to communicate with the central location over the communication network. Respective times within the first time period are established at which each of the remote terminals initiates its attempt to communicate with the central location. A number of the remote terminals which successfully communicate with the central location to transmit information therebetween is monitored. The first time period is then decreased to a second time period if the number of remote terminals which successfully communicate with the central location is less than the capacity of the central location. Respective times within the second time period then established at which remote terminals which have not initiated their respective attempts to communicate with the central location will initiate their attempts to communicate with the central location. The above steps are repeated to establish a time period at which the number of remote terminals which communicate with the central location is approximately equal to the capacity of the central location. The time period thus set is maintained until each of the remote terminals has initiated its attempt to communicate with the central location.

Also in accordance with the present invention, apparatus for controlling a transmission of information over a communication network between a population of remote terminals and a central location having a capacity of simultaneously communicating with a predetermined number of remote terminals in the population is provided. The apparatus includes means for fixing a first time period during which every remote terminal could initiate one attempt to communicate with the central location over the communication network. A monitor monitors a number of remote terminals which successfully communicate with the central location to transmit information therebetween. Means responsive to the monitoring means discretely decreases the first time period until the number of remote terminals which successfully communicate with the central location is approximately equal to the capacity of the central location. Means responsive to the means for decreasing instructs the remote terminals which have not initiated their attempt to communicate with the central location to establish respective times within the discrete time periods fixed by the means for decreasing at which the remote terminals initiate their attempts to communicate with the central location.

Finally, in accordance with the present invention, apparatus for transferring information over a communication network to a central location is provided. The apparatus includes a receiver for receiving instructions from the central location. The instructions include instructions for initiating attempts to transfer information to the central location in accordance with a transmission window and a transmission sequence. Means responsive to the instructions establish a first time within the transmission window at which the apparatus could initiate an attempt to communicate with the central location. A transmitter transmits the information over the communication network if the apparatus successfully communicates with the central location. Means responsive to the instructions establish a second time within the first transmission window at which the apparatus initiates an attempt to communicate with the central location if the apparatus has not attempted to initiate communication with the central location and an end time of the first transmission window is changed.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the present invention and many of the attendant advantages thereof will be readily obtained as the invention becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings.

FIG. 1 is block diagram of a prior art satellite television system.

FIG. 2 is a block diagram of a satellite television system in which the present invention may be implemented.

FIG. 3 is a block diagram of the integrated receiver decoder of FIG. 2.

FIG. 4 is a block diagram of the descrambler shown in FIG. 3.

FIG. 5 illustrates in greater detail the system components for transferring data.

FIG. 6 is a graph illustrating the call-in technique of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention is described below in terms of a B-MAC satellite television system. Although a B-MAC system is specifically described, the invention may be applied to other MAC systems such as C-MAC, D-MAC, and D/2-MAC. The invention may also be implemented in NTSC (National Television Standards Committee), PAL, SECAM, or high definition television systems. The present invention is broadly applicable to systems for establishing communication over a communication network between a central location and

a plurality of remote units, particularly remote units distributed over a large geographical area.

A B-MAC satellite television system in which the present invention may be implemented is shown in block form in FIG. 2. B-MAC encoder 201 encodes a source program 202 for transmission over a satellite link 205 to an integrated receiver-decoder (IRD) 206. Program source 202 may include video, audio, and data information. The source program information is scrambled in a program scrambler of B-MAC encoder 201 using a key (as discussed above). The scrambled programs and key are transmitted through satellite link 205. IRD 206 receives the scrambled programs and key. The key is recovered from the received signal, stored in a key memory and applied to a program descrambler which descrambles the scrambled program and outputs unscrambled program 209 for display on television 220.

IRD 206 is coupled to public switched telephone network 207. The telephone network is coupled to a phone processor 208 for receiving calls initiated by the IRDs in the network. The phone processor may comprise, for example, a Scientific Atlanta Model 8554-001 Phone Processor, available from the assignee of the present application. A current implementation utilizes eight model 8554-001 processors to handle incoming calls. A phone manager computer 209 such as a Compaq SystemPro controls phone processor 208.

Phone manager computer 209 is coupled to business system computer 210 for compiling and processing billing information to bill subscribers. Phone manager 209 is also coupled to a subscriber authorization computer (SAC) 211 which controls, for example, the authorization of subscribers to receive particular programming. Subscriber authorization computer 211 contains information such as program tiers for a current month, credit limits, service tiers, call-in billing group, call-in time zone, call-in phone number, and store and forward disable for decoders in the network. Subscriber authorization computer 211 is coupled to B-MAC encoder 201 to permit communication between computer 211 and the IRDs in the network over satellite link 205. Finally, a system supervisory control computer 212 coupled to phone manager 209 and B-MAC encoder 201 controls the overall operation of the system.

Data or commands are transmitted to decoders in the network over satellite link 205 in at least two ways. In a first way, system data generated by supervisory control computer 212 carries program specific data for the channel currently tuned by a decoder. In a second way, addressed data packets (ADPs) are used to deliver decoder specific information to a single decoder. Each decoder in the network is assigned a unique user address and a matching secret serial number (SSN). When an addressed packet with an address matching the user address of a decoder is received, the packet is decrypted with the SSN. The packets preferably include a checksum which is used to verify both correct reception and decryption with a matching SSN. Typically, system data originates from supervisory control computer 212 as noted, while addressed data packets originate from subscriber authorization computer 211, although the invention is not limited in this respect.

FIG. 3 is a block diagram of B-MAC IRD 206 shown in FIG. 2. H/V switch 301 switches between the horizontal and vertical polarities of the incoming transmission over satellite link 205. The incoming signal then passes to block 302 including a downconverter, a tuner, and demodulator. The downconverter and tuner select a channel from the incoming signal and lower it to some intermediate frequency (IF). The tuner may, for example, comprise a synthesized tuner. The demodulator demodulates the signal to generate composite baseband video which is input into B-MAC decoder 303. Front panel 305 includes an IR receiver 306, user keypad 307, and LED display 308. IR receiver 306 is adapted to receive control signals from an associated IR remote control (not shown). User keypad 307 includes a plurality of keys 310 for permitting the subscriber to input, for example, channel selections and volume control. LED display 308 displays the tuned channel and may display other information such as time. Power supply 310 supplies power to IRD 206.

A tuning and front panel control processor 304 may comprise a MC68HC05C4 and tunes the transponder tuner in block 302, scans front panel keypad 307 and any remote keypads for keystrokes, drives LED display 308 and provides volume control. Keystroke interpretation is generally performed by display control processor (DCP) 405 (see FIG. 4), except for volume control, which is internal to tuning processor 304. Volume control keystrokes are passed to DCP 405, but function only to instruct DCP 405 to un-mute audio.

B-MAC decoder 303 decodes the composite baseband video input thereto and outputs NTSC video and audio as shown. VHF modulator 311 modulates the video and audio outputs of B-MAC decoder 303 for reception by television receiver 220 (FIG. 2). Modem 313 allows IRD 206 to interface with the public switched telephone network to permit communication between IRD 206 and a system operator. For example, billing information related to impulse pay-per-view purchases may be transferred to the system operator. Alternatively, information from the cable operator may be transferred to IRD 206 over the telephone network. B-MAC decoder 303 is also coupled to a security card receptacle 315 for receiving an insertable security card. A description of the insertable security card and its operation are described in commonly assigned copending application Ser. No. 07/677,460 filed Mar. 29, 1991 and entitled "Independent External Security Module For a Digitally Upgradeable Television Signal Decoder", which is incorporated herein by reference.

FIG. 4 is a detailed block diagram of B-MAC descrambler 303 of FIG. 3. The baseband B-MAC signal is input to AGC and clamping block 401 for performing well-known gain control and clamping operations. Block 402 includes a phase lock loop and a clock divider for generating system clock signals used in decoder operation. Attention is directed to U.S. Pat. No. 4,652,903, assigned to the assignee of the present application and incorporated herein by reference, for a description of a technique of generating clock signals. Block 402 also includes a data slicer for providing data contained in the incoming signal to microprocessor and teletext support interface (MATS) 403 and video descrambler 404. MATS 403 performs data error correction and data formatting on both incoming system data and addressed data packets and supplies the corrected and formatted data to display and communications processor (DCP) 405. DCP 405 may comprise a MC68HC11E9 and performs overall control of the other processors of decoder 303 and of all user interfaces.

The luminance and chrominance signals of the B-MAC signal are respectively provided to luminance digital linestore 406 and chrominance digital linestore

407. The decompressed luminance signal is provided to digital-to-analog converter 408 and then to low pass filter 409, where it is filtered. The analog luminance signal then goes to output interface 415. The sampling signals necessary to decompress luminance are produced by a timing generator in block 404 and supplied to luminance digital linestore 406 by clock drivers.

The chrominance signal is decompressed in digital chrominance store 407. Separate outputs are provided for the two color difference signals, which are passed through respective digital-to-analog converters 410 and 411. The color difference signals are then respectively passed through low pass filters 412 and 413, where they are filtered. The filtered signals are provided to output interface 415. The necessary sampling signals are supplied to chrominance store 407 from a timing generator in block 404 through clock drivers. Audio information is provided to block 417 including an audio decryptor, a demultiplexor and a digital volume control. The audio information then passes to block 418 including a Dolby ® adaptor, a delta modulator, and a digital-to-analog converter. Teletext character generator ROM 420 and teletext RAM 421 are coupled to DCP 405 and MATS 407 for providing teletext characters to output interface 415 in accordance with teletext information contained in the incoming B-MAC signal. Output interface 415 outputs a standard NTSC video output. DCP 405 is also coupled to inboard security element (ISE) 423 and receptacle 315 for receiving an outboard security element (OSE). The ISE and OSE and their operation are discussed in detail in the above-identified copending application Ser. No. 07/677,460. Generally, only one of the ISE or OSE is active at a given time. Finally, DCP 405 is coupled to a phone processor 430 for interfacing the decoder and the public switched telephone network. Phone processor 430 may comprise a MC68HC05C4 and controls modem communication and tone generation. Since the modem transfers billing information representing revenue to the cable operator, telephone communications are preferably encrypted for security. The encryption takes place in one of ISE 423 or the OSE processors (whichever is active) before being passed to the modem. If the modem is utilized to receive information, such information is passed on verbatim to ISE 423 or the OSE. The active security element may initiate a call when commanded by system data or by an addressed data packet. The inactive security element may initiate a call only when commanded by an addressed data packet.

FIG. 5 illustrates in greater detail the components used to transfer data from subscriber IRD 206 to phone manager 209. The active processor (either ISE 423 or the OSE) initiates a phone call via modem 313 over public switched telephone network 207. Phone processors 208*a*, 208*b*, . . . 208*n* are provided to receive phone calls from the subscriber IRDs in the network. Phone processors 208*a*, 208*b*, . . . 208*n* are coupled to phone manager 209. A console 225 is coupled to phone manager 209 for permitting operator access to phone manager computer 209. Phone manager 209 is coupled both to business system computer 210 and subscriber authorization computer (SAC) 211.

Phone manager 209 serves as a front end processor for business computer 210. Phone manager 209 requests decoders to call in via their telephone links and collects the information provided by each decoder. Phone manager 209 normally instructs system supervisory control computer 212 to generate system data which commands large portions of the population of decoders to call in as described below. If a decoder does not call in when commanded by the above method, it is explicitly addressed and commanded to call in. If it persistently fails to call in, it is considered non-responding. The data transferred from the IRDs in the network is stored in real time in non-volatile memory of phone manager 209 and is available to be uploaded to the business computer 210 at any time. Business computer 210 controls phone processor 209 and sends commands to control the next function to be performed.

Specifically, phone manager 209 generates requests requesting that the IRDs in the network attempt to initiate communication over the telephone network. These "callbacks" may be initiated by (1) an internal callback scheduler of phone manager 209 e.g. biweekly, monthly; (2) requests from business computer 210; or (3) the phone manager operator console 225. The callback request is formatted and forwarded to subscriber authorization computer (SAC) 211 or system supervisory control 212 in accordance with the type of callback, i.e., either individual or group, respectively. A callback command is then sent, in the encrypted B-MAC data stream, to the IRDs.

An IRD responds to the request by attempting to establish communication with phone processor 209 as follows. The IRD engages the telephone line and checks for dial tone. The IRD then dials a telephone number retrieved from EEPROM associated with the active security element. The telephone number is previously transmitted to the IRD in an addressed data packet from the subscriber authorization computer. If a phone connection is established, the IRD sends a self-identification message to phone manager 209. The phone manager then sends an acknowledgment to the IRD, with a command to upload, for example, IPPV viewing data. The IRD then uploads its IPPV viewing data to the phone manager. The phone manager sends an acknowledgment to the IRD and the IRD clears its IPPV viewing data from non-volatile memory. The IRD then releases the phone line.

It is emphasized that the present invention is not limited to uploading data from a population of remote terminals to a central location, but may also be used to download data from a central location to a population of remote terminals or a subset thereof.

Decoder 206 preferably permits impulse pay-per-view purchases. A number of methods are known in the art which permit a subscriber to purchase an impulse pay-per-view event. Several methods will be briefly identified, although it will be recognized the invention is not limited in this respect. For example, a system operator may define a period of time known as a purchase window. This purchase window may begin at a first time, e.g. a half hour before the beginning of the event, and end at a second time, e.g. fifteen minutes after the event has begun. It will be apparent that different purchase windows may be implemented. At any time during the purchase window, a subscriber may push a "BUY" key on either the front panel of the IRD or on a remote control for transmitting a "BUY" signal to the IRD. The active security element then authorizes the video descrambler to descramble the event. Billing information including, for example, an event ID and a purchase time and date is generated and stored in non-volatile memory. Alternatively, a subscriber may also pre-purchase an impulse pay-per-view event by using either the front panel keypad or the remote control

keypad to enter an event ID into non-volatile authorization memory. When the event is active and IRD 206 determines that the active event ID matches the event ID of the pre-purchased event, the active security element authorizes the descrambler to descramble the event. Further, the system operator may also implement a credit system in which credits are downloaded to each subscriber IRD. When a subscriber wishes to purchase an impulse pay-per-view event, the number of credits is checked. If there are sufficient credits, the event is authorized. If not, the event is not authorized. The subscriber is preferably informed via a text screen that the event may not be purchased since his credit is insufficient. When a credit system is used, the event ID and the purchase date may be stored in non-volatile memory so that the system operator can, for example, determine a buy rate for a particular event. Exemplary pay television system are disclosed, for example, in U.S. Pat. Nos. 4,484,217 and 4,163,254 to Block, incorporated herein by reference.

In the present system, as a subscriber purchases IPPV programs, billing information or purchase data such as event ID and purchase date and time is accumulated in a secure EEPROM memory of the active security element. The purchase data remains in memory until forwarded to the system operator through the telephone interface. As noted above, there are two call-in mechanisms, which may operate concurrently, used by phone manager 209 to recover the purchase data. The first mechanism is a group command and the second mechanism is an individual command. The group command uses system data generated by the supervisory control computer and sent over the global satellite channel to specify large groups of decoders which are to call in and transfer data. Individual commands direct particular decoders to call in by addressing them with addressed data packets. Since data such as billing information represents revenue to the system operator, it is important that such information be collected quickly and efficiently.

Several definitions are presented for the discussion below. Call-in class is defined as a set of all decoders which satisfy conditions specified in a call-in command in system data. A call-in window is defined as a period of time during which every decoder in a call-in class will initiate a single phone call to the phone processor. A sequence is defined as a plurality or succession of call-in windows. A call-in window starts when a sequence number is changed. Preferably, a window starts when the sequence number is incremented by one. A call-in group is defined as a set of decoders which initiate calling on a particular clock-tick after the start of a call-in window. The length of each clock-tick is 64/60 seconds in a preferred embodiment, although the invention is not limited in this respect. The window end time is a sixteen bit number transmitted in system data which indicates when a current window is scheduled to end. The window end time is relative to the time when the window timer is equal to zero.

The number of clock ticks in any call-in window is given by

$$\text{Window} = (\text{Window End Time}) \text{ in ticks.} \quad (1)$$

Since a window end time is a sixteen bit number, a call-in window can assume values in a range from 0 to 2^{16} ticks or approximately 19 hours. A single group initiates calls on a clock tick and all groups call in within a call-in window. Thus, the number of groups per window is given by equation (1). In response to a call-in command, each decoder selects a group number randomly from the range of group numbers allowed. That is, the decoders generate respective times during the window and initiate calls at the times so generated. Preferably, the times generated by the decoders produce a uniform distribution of incoming calls to the phone processor. In a current embodiment, this is done in accordance with the following equation:

$$\text{Group} = (\text{Rand} * \text{Window})/65536 \quad (2)$$

where Rand is a random number from 0 . . . 65535. Rand is a sixteen bit random number. Preferably, the unit address is not used as Rand, since it is not expected to have a uniform distribution over the range 0 . . . 65535. Preferably, Rand is a psuedo random number and changes from one window to the next and when a window is resized in order that each new window have a uniform distribution of decoders calling in. This may be implemented, for example, by having a set of 32 random bits and choosing a different sixteen each time by doing a rotate.

Alternatively, a truly random number may be stored in EEPROM. The truly random number of, for example, sixteen bits may seed a random number generator which executes a predetermined number of loops to generate Rand. When a window is resized, the random number generates executes more loops to generate a new value of Rand. The random number generator may be reseeded when a new window is opened. It will be appreciated that other techniques of generating random numbers may be implemented and the present invention is not limited in this respect.

In accordance with the invention, the window size is initially fixed to the maximum length, i.e., approximately 19 hours. The number of incoming calls to phone processors 208*a*, 208*b*, . . . 208*n* is monitored. Phone manager 209 is capable of simultaneously processing a predetermined number of calls N based on the number of phone processors and phone manager software. As the callback progresses, the number of incoming calls is monitored and the window is shrunk to generate a number of incoming calls from the decoders substantially equal to the number of calls capable of being simultaneously handled by phone processors 208*a*, 208*b*, . . . 208*n* and phone manager 209. This method is illustrated in the time line graph of FIG. 6. With reference to FIG. 6, the number of calls N capable of being simultaneously handled by phone processors 208*a*, 208*b*, . . . 208*n* and phone manager 209 is represented by line 610. With the window initially set at the maximum time period T1, the actual number of calls received by the phone processor during the time interval from t_0 to t_1 is shown by the line 620. t_0 is the initial window start time and t_1 is a time less than T1. Since line 620 indicates that the number of incoming calls is less than the number of calls capable of being processed, the window is shrunk to some time T2 less than T1. When this is done, the IRDs which have not yet attempted to call phone processor 209 then calculate a new callback time in accordance with the formula

$$\text{group} = (\text{random\#X window end time})/65535 \quad (3)$$

and the decoder callback timer is reset to zero. Preferably, the random number utilized in equation (3) changes

whenever the window is resized. When this is carried out, it can be seen by reference to line 630 that the actual number of incoming calls during the time interval from t_1 to t_2 increases. Thus, the number of calls actually received by the phone processors is closer to the number of calls N capable of being simultaneously handled. By reducing the window still further to T3 and again calculating a new group for each of the IRDs which have not yet initiated an attempt to call in, it can be seen that the actual number of calls may be made approximately equal to the number of calls capable of being processed. Accordingly, the window size is maintained at T3 until time t is equal to T3 and the window ends.

When a call-in is requested through system data, the decoder first calls-in in accordance with the above method. If it gets a busy signal, or cannot complete the call, a "Retry" bit is set. Thus, when a retry window is opened by the system operator, all decoders with the retry bit set should call in. The retry bit should be cleared when a call-in is successful. If a decoder is scheduled to call in, but the window ends prematurely, the retry bit is not set.

When an addressed data packet is used to force a call-in, the decoder calls in as soon it receives and processes the command. If it gets a busy signal or cannot complete the call, the retry bit preferably remains set.

Thus, in real time, the window end time is changed, causing decoders to call in at a rate substantially equal to the rate of calls capable of being processed by the phone processor. For proper operation, it should be emphasized that the sequence number should not be changed until after the proper end time for the window.

An algorithm for the decoding implementing the above procedures is attached as an Appendix to this specification.

In order to effect enhanced control over the call-in, the present invention includes the following call-in modes:

(1) EVENT
(2) BUFFER
(3) RETRY
(4) STOP

In the EVENT mode, decoders which have purchased a particular event, characterized by an event ID, are commanded to call-in. In the BUFFER mode, decoders which have purchased a predetermined or threshold number of events are commanded to call-in. Thus, for example, decoders which have purchased five or more events may be commanded to call-in the BUFFER mode. In the RETRY mode, decoders which were unable to successfully call-in in a previous call-in window and have a retry bit set as described above are commanded to call-in. In the STOP mode, decoders in the population are commanded not to initiate attempts to call-in.

Each of these call-in modes includes several qualifiers for controlling which decoders actually attempt to call-in in a given mode. The first qualifier is a region code consisting of a time zone and a billing group which is recognized only in EVENT, BUFFER, and RETRY modes. In the United States for example, the time zone may be Eastern, Central, Mountain, or Pacific in accordance with the location at which a decoder is installed. The billing group is determined by the system operator and may, for example, be fixed in accordance with the day of the month on which a decoder was installed. Thus, in accordance with the region code, decoders in the Eastern Time Zone which were installed on the fifth day of the month may be commanded to call-in a given mode. The system may instruct decodes to ignore their billing groups by setting this qualifier to 0. Thus, by setting billing group to 0, decoders in a specified time zone may be commanded to call in. A second qualifier is a global bit which, when set in EVENT, BUFFER and RETRY modes, instructs the decoders to ignore time zone. Thus, by setting the global bit, decoders in any time zone which were installed on the fifth day of a month may be commanded to call-in in a given mode. In stop mode the global bit causes decoders to clear retry bit. A third qualifier is the sequence number which identifies a particular call-in window. As noted above, the sequence number is incremented each time a new window is opened. If a decoder has previously attempted to call-in during a window having a given sequence number, it will ignore subsequent call-in commands having the same sequence number. When a decoder is unable to call-in for any reason, it is a failed attempt and a retry bit is set in non-volatile memory. In the RETRY mode, only those decoders having the retry bit set will call-in. Finally, the window size is a qualifier which determines the length of the call-in period or window during which the decoders call-in.

Unlike the system described, for example, in PCT 89/10670, the decoders in the present invention will not retry unless explicitly instructed by the system operator. Further a wayward initial guess by the system operator as to the number of calls that will be generated by the call-in command resulting in short window would result in a large number of decoders being unable to get through. Since decoders do not retry in the present invention, those decoders which could not get through during the initial system overload would be lost for that window. Accordingly, in the present invention, it is important to start out with a large window and then shrink the window to generate the best utilization of the phone processor facilities. Any overloading of the system caused by a poor initial guess or shrinking the window too much or too quickly is to be avoided since those decoders which receive a busy signal or can't get through due to overloading must be commanded by an addressed data packet or system data in a RETRY mode to call-in, resulting in inefficient system operation. Since the population may consist of up to two million decoders, a failure of even a small percentage of decoders to transfer billing information can represent a significant revenue for the system operator.

Non-responding decoder detection is initiated during normal call-in modes. Every incoming call sets a "CALLED" flag in the phone manager database. After a predetermined time period such as a day, a batch process runs which is aware of all the decoders which should have called in since the last time the batch process ran. Each decoder in the database is examined to see whether it should be called in. If so, its CALLED flag is checked. If this is clear, the decoder has not called in and is placed on a forced call-in list. After each decoder in the database is examined, all CALLED flags in the database are then cleared.

At some subsequent time, a time period is set aside for forced mode operation. The forced call-in list is downloaded in the form of commands to the subscriber authorization computer 211. These commands are preferably spaced out in time in order to avoid overloading the system with calls. Every entry in the forced call-in list has a counter called the call-in fail counter. Every day before entering forced mode, this counter is incre-

mented for each element in the list. This indicates that the record has spent another day on the list without a call coming in. When a call comes in, if the decoder is in the forced call-in list, it is removed from that list. Periodically, business computer 210 uploads from the phone manager database the records in the forced call-in list whose call in fail counters are above a certain level. This information may then be printed out to permit appropriate action to be taken by the system operator. These decoders will remain on the forced call-in list until the business computer sends a delete decoder or deactivate decoder command.

Although the present invention is particularly concerned with the collection of IPPV data from remote terminals, other data may also be collected in accordance with the above-described procedure. For example, viewing statistics regarding a subscriber's viewing habits may also be collected for processing.

All applications and patents referenced above are incorporated herein by the respective references thereto.

Although illustrative embodiments of the present invention have been described in detail with reference to the accompanying drawings, it is to be understood that the invention is not limited to those precise embodiments and that various changes and modifications may be effected therein by those in the art without departing from the scope and spirit of the invention.

APPENDIX

Decoder Algorithm

```
Power Up
If not tried to call {
    increment retries
    tried to call = yes
{
Repeat forever {
    if new window {
      store sequence #
      if decoder part of call-in window {
        tried to call = no
        call waiting = yes
      }
    }
    if (new window or new end window time) and call waiting {
      get a random #R (0 . . . 65535)
      group = (R × window end time) / 65535
      timer = 0
    }
}
for every tick {
    if group <timer and call waiting {
        call – waiting = no
        call – dialled = yes
        initiate call-in
        tried to call = yes
    }
}
for every phone micro packet }
    if call dialled {
      if phone data request packet {
      get data and place in response buffer
      if response = hang up
        clear retries
      }
    }
    if phone poll packet {
      send response buffer
      if response = hang up {
        call – dialled = no
      }
    }
}
```

We claim:

1. A method for transmitting information over a communication network between a population of remote terminals and a central location having a capacity of simultaneously communicating with a predetermined number of remote terminals in said population, the method comprising the steps of:

(A) fixing a sequence of at least two call-in windows each having an initial maximum length, a first call-in window defining a time period during which each remote terminal in said population of remote terminals will initiate a single attempt to communicate with said central location over said communication network and a second call-in window defining a time period during which remote terminals which were unsuccessful in their attempt to communicate with said central location during the first call-in window will initiate another single attempt to communicate with said central location over said communication network;

(B) prompting said remote terminals to establish respective times within the first call-in window at which each of said remote terminals in said population of remote terminals will initiate its attempt to communicate with said central location;

(C) monitoring a number of said remote terminals which simultaneously communicate with said central location to transmit information therebetween during the first call-in window;

(D) varying the length of the first call-in window if the number of remote terminals which simultaneously communicate with said central location is less than the capacity of said central location, wherein the length of the first call-in period is varied so as to be decreased, but not increased;

(E) prompting remote terminals which have not yet initiated their attempt to communicate with said central location to establish new respective times within the varied first call-in window for initiating their attempt to communicate with said central location;

(F) repeating steps (C)–(E) to establish a final minimum length of the first call-in window at which the number of said remote terminals which simultaneously communicate with said central location is approximately equal to the capacity of said central location;

(G) maintaining the final length of the first call-in window set in step (F) until each remote terminal in said population of remote terminals has initiated its attempt to communicate with said central location;

(H) prompting remote terminals which were unsuccessful in their attempt to communicate with said central location during the first call-in window to establish respective times within the second call-in window for initiating their attempt to communicate with said central location; and

(I) repeating steps (C)–(G) for the second call-in window.

2. The method according to claim 1 further comprising the step of:

dividing said population into a plurality of classes of remote terminals such that only remote terminals within particular classes initiate attempts to communicate with said central location over said communication network.

3. The method according to claim 2 wherein the step of dividing said population into a plurality of classes

comprises dividing said population into a plurality of classes in accordance with a geographic location of respective remote terminals.

4. The method according to claim 3 wherein the population is divided in accordance with a time zone in which respective remote terminals are disposed.

5. The method according to claim 1 wherein information is transmitted from said remote terminals to said central location.

6. The method according to claim 1 wherein information is transmitted from said central location to said remote terminals.

7. The method according to claim 1 wherein said communication network comprises a public switched telephone network.

8. The method according to claim 1, wherein the step (B) of establishing respective times within the first call-in window comprises:

establishing respective times in accordance with the formula

(RAND*Initial Window End Time)/(Initial Window End Time)

wherein the Initial Window End Time is determined by the initial length of the first call-in window and RAND is a first random number between zero and the Initial Window End Time.

9. The method according to claim 8, wherein RAND is a pseudo-random number.

10. The method according to claim 8, wherein the step (E) of establishing new respective times within the decreased first call-in window comprises:

establishing new respective times in accordance with the formula

(RAND*Decreased Window End Time)/(Initial Window End Time)

wherein the Initial Window End Time is determined by the initial length of the first call-in window, the Decreased Window End Time is determined by the length of the decreased first call-in window, and RAND is a second random number between zero and the Initial Window End Time.

11. The method according to claim 10, wherein the first random number is different than the second random number.

12. A method for transmitting information over a communication network between a population of remote terminals and a central location having a capacity of simultaneously communicating with a predetermined number of remote terminals in said population, the method comprising the steps of:

(A) fixing a sequence of at least tow call-in windows each having an initial maximum length, a first call-in window defining a time period during which each remote terminal in said population of remote terminals will initiate a single attempt to communicate with said central location over said communication network and a second call-in window defining a time period during which remote terminals which were unsuccessful in their attempt to communicate with said central location during the first call-in window will initiate another single attempt to communicate with said central location over said communication network;

(B) prompting said remote terminals to establish respective times within the first call-in window at which each of said remote terminals in said population of remote terminals will initiate its attempt to communicate with said central location;

(C) monitoring a number of said remote terminals which simultaneously communicate with said central location to transmit information therebetween during the first call-in window;

(D) varying the length of the first call-in window if the number of remote terminals which simultaneously communicate with said central location is less than the capacity of said central location, wherein the length of the first call-in period is varied so as to be decreased, but not increased;

(E) prompting remote terminals which have not yet initiated their attempt to communicate with said central location to establish new respective times within the varied first call-in window for initiating their attempt to communicate with said central location;

(F) repeating steps (C)–(E) to establish a final minimum length of the first call-in window at which the number of said remote terminals which simultaneously communicate with said central location is approximately equal to the capacity of said central location;

(G) maintaining the final length of the first call-in window set in step (F) until each remote terminal in said population of remote terminals has initiated its attempt to communicate with said central location;

(H) setting a retry flag in remote terminals which initiate unsuccessful attempts to transfer information to said central location; and

(I) repeating steps (A)–(G) during the second call-in window for those remote terminals whose retry flag is set.

13. Apparatus for controlling a transmission of information over a communication network between a population of remote terminals and a central location having a capacity of simultaneously communicating with a predetermined number of remote terminals in said population, said apparatus comprising:

means for fixing a sequence of at least two call-in windows each having an initial maximum length, a first call-in window defining a time period during which each remote terminal in said population of remote terminals will initiate a single attempt to communicate with said central location over said communication network and a second call-in window defining a time period during which remote terminals which were unsuccessful in their attempt to communicate with said central location during the first call-in window will initiate another single attempt to communicate with said central location over said communication network;

means responsive to said means for fixing for prompting said remote terminals to establish respective times within the first call-in window at which each of said remote terminals in said population of remote terminals will initiate its attempt to communicate with said central location;

monitoring means for monitoring a number of remote terminals which simultaneously communicate with said central location to transmit information therebetween during the first call-in window;

means responsive to said monitoring means for discretely varying the length of the first call-in win-

dow until the number of remote terminals which simultaneously communicate with said central location is approximately equal to the capacity of said central location, said varying means varying the length of the first call-in period so as to be decreased, but not increased;

means responsive to said varying means for prompting remote terminals which have not yet initiated their attempt to communicate with said central location to establish new respective times within said discrete time periods at which said remote terminals will initiate their attempts to communicate with said central location.

14. Apparatus for transferring information over a communication network to a central location, said apparatus comprising:

receiving means for receiving instructions from said central location including instructions for initiating attempts to transfer information to said central location in accordance with a sequence comprising at least two call-in windows;

means responsive to instructions from said central location for establishing a time within a first call-in window at which said apparatus will initiate an attempt to communicate with said central location;

means for attempting to communicate with said central location at the time within the first call-in window;

means for transmitting the information over said communication network if said apparatus successfully communicates with said central location;

means for setting a retry flag if said apparatus is unsuccessful in the attempt to communicate with said central location;

means responsive to instructions from said central location for establishing a new time within the first call-in window at which said apparatus will initiate an attempt to communicate with said central location if said apparatus has not attempted to initiate communication with said central location and an end time of the first call-in window is changed; and

means responsive to instructions from said central location for establishing a time within a second call-in window at which said apparatus will initiate an attempt to communicate with said central location if said retry flag is set.

15. A method of transferring information over a communication network from a remote apparatus to a central location, the method comprising the steps of:

receiving instructions from said central location including instructions for initiating attempts to transfer information to said central location in accordance with a sequence comprising at least two call-in windows;

establishing a time within a first call-in window at which said apparatus will initiate an attempt to communicate with said central location in accordance with instructions from said central location;

attempting to communicate with said central location at the time within the first call-in window;

transmitting the information over said communication network if said apparatus successfully communicates with said central location;

setting a retry flag if said apparatus is unsuccessful in the attempt to communicate with said central location;

establishing a new time within the first call-in window at which said apparatus will initiate an attempt to communicate with said central location in response to instructions from said central location if said apparatus has not attempted to initiate communication with said central location and an end time of the first call-in window is changed; and

establishing a time within a second call-in window at which said apparatus will initiate an attempt to communicate with said central location in accordance with instructions from said central location if said retry flag is set.

* * * * *

US006237146B1

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Richards et al.

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(45) **Date of Patent: May 22, 2001**

(54) **SYSTEM AND METHOD OF BIDIRECTIONAL DIGITAL VIDEO COMMUNICATION OVER A CABLE**

(75) Inventors: **Claudia K. Richards**; **William M. Buchanan**, both of Hampstead, NH (US)

(73) Assignee: **Lucent Technologies, Inc.**, Murray Hill, NJ (US)

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(22) Filed: **Mar. 19, 1997**

(51) **Int. Cl.**[7] **H04N 7/173**

(52) **U.S. Cl.** **725/100**; 725/131; 725/132; 370/448

(58) **Field of Search** 709/217–219; 348/6, 7, 12, 13, 10; 455/3.1, 4.1, 4.2, 5.1, 6.1, 6.2; 370/445, 446, 447, 448; 725/114, 131, 132, 91, 100, 103, 86

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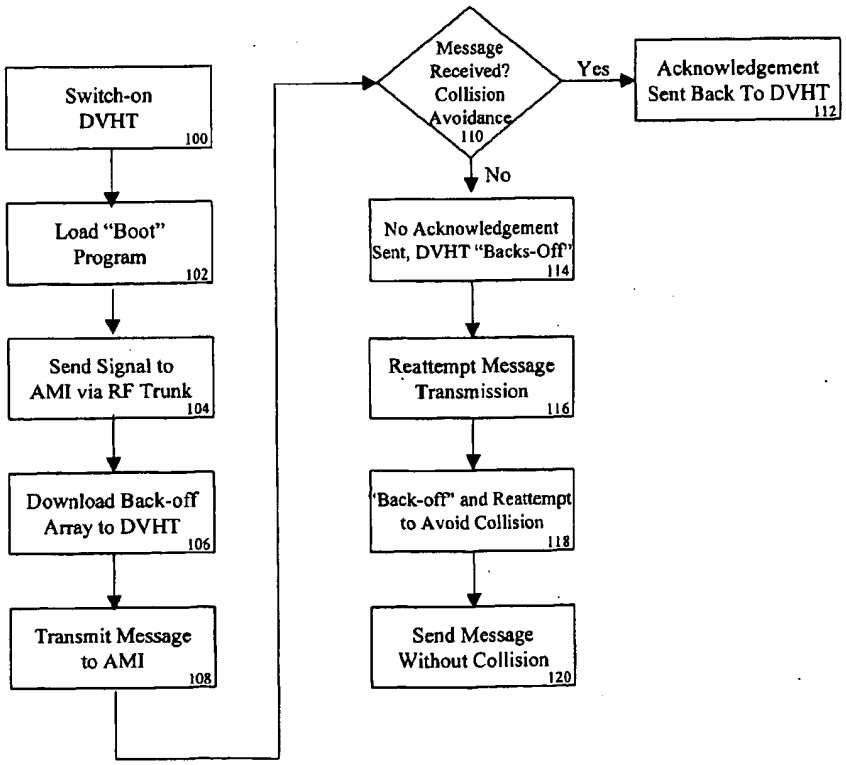
Primary Examiner—John W. Miller
(74) *Attorney, Agent, or Firm*—Morgan & Finnegan LLP

(57) **ABSTRACT**

In accordance with the present invention, a cable system allows bidirectional digital communication between a plurality of subscriber Digital Video Home Terminals each located at a different subscriber location and a cable headend via a RF Trunk. The cable headend has a processor for calculating and storing a randomized back-off array for each of the plurality of subscriber Digital Video Home Terminals. Each subscriber Digital Video Home Terminal receives the randomized back-off array for controlling through an algorithm when a Digital Video Home Terminal attempts to send a message to a cable headend. If a collision between the two messages is imminent, the last Digital Video Home Terminal to send the message backs-off and then reattempts to send the message a plurality of times after a random back-off interval of time has passed after each reattempt until no collision would occur with another message generated from a different Digital Video Home Terminal.

20 Claims, 3 Drawing Sheets



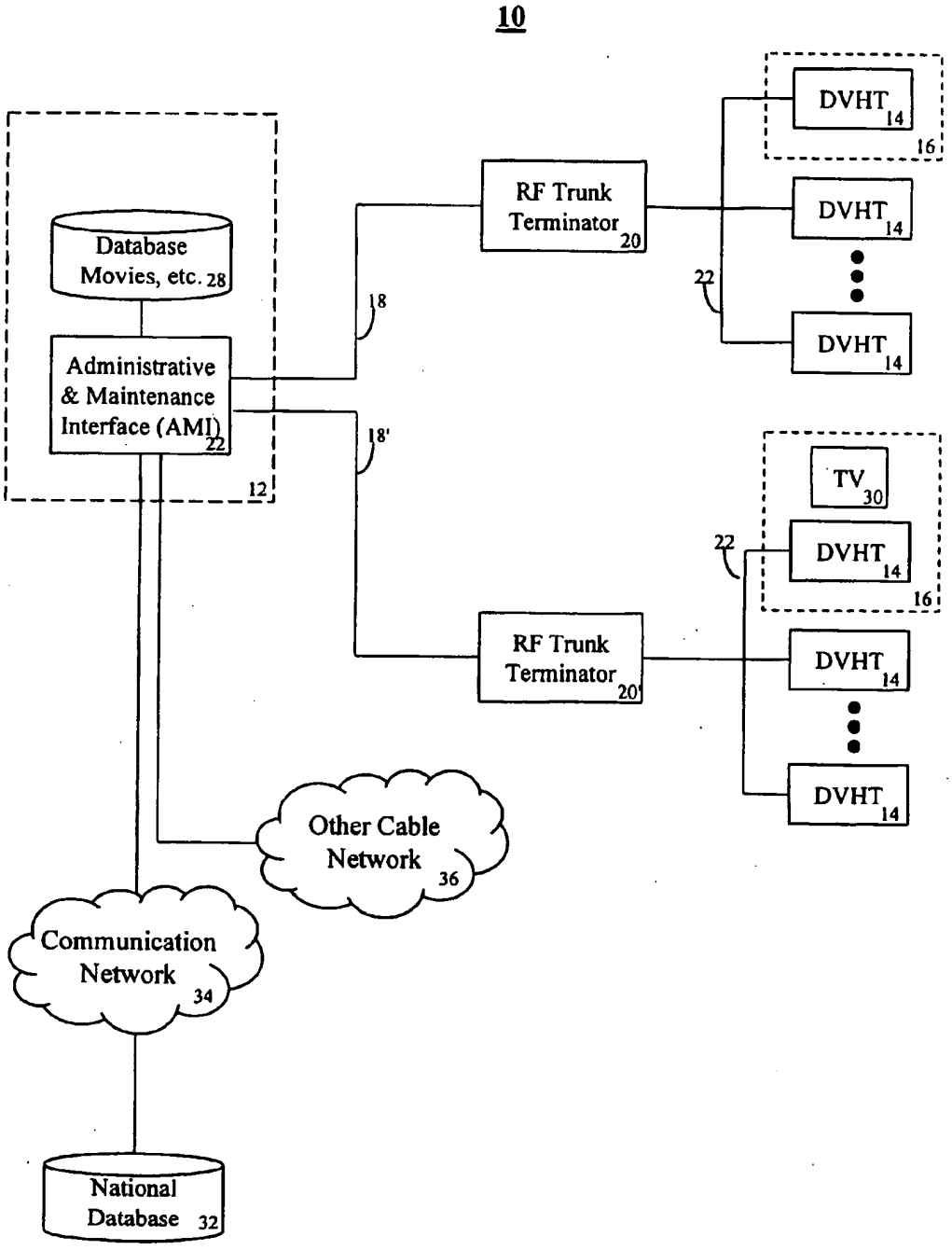

10
DVHT 14
16
RF Trunk Terminator 20
DVHT 14
22
DVHT 14
Database Movies, etc. 28
18
Administrative & Maintenance Interface (AMI) 22
18'
12
TV 30
22
DVHT 14
16
RF Trunk Terminator 20'
DVHT 14
DVHT 14
Other Cable Network 36
Communication Network 34
National Database 32

FIG. 1

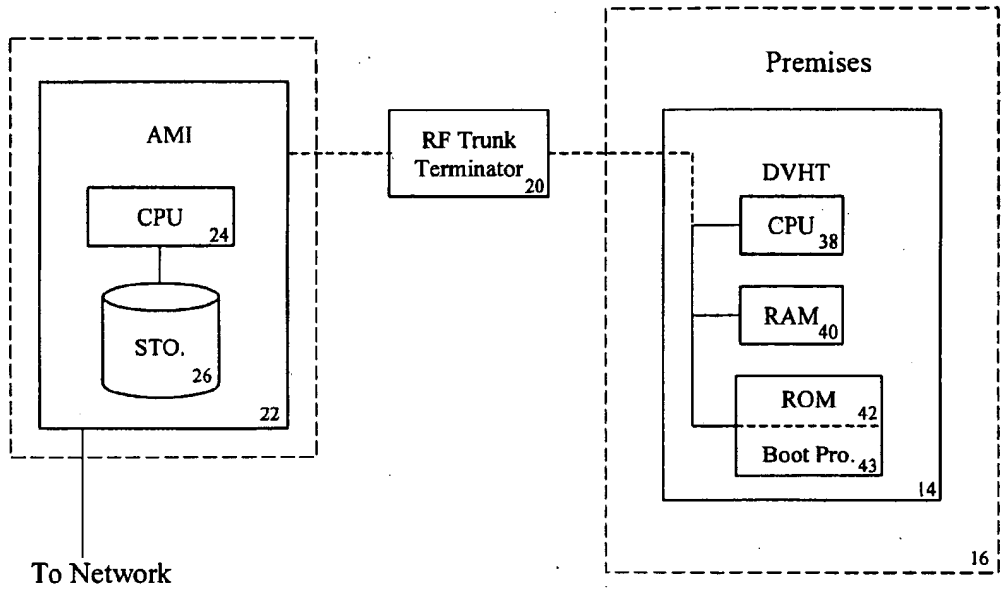

AMI
CPU
24
STO.
26
22
To Network
RF Trunk
Terminator
20
Premises
DVHT
CPU
38
RAM
40
ROM
42
Boot Pro.
43
14
16

FIG. 2

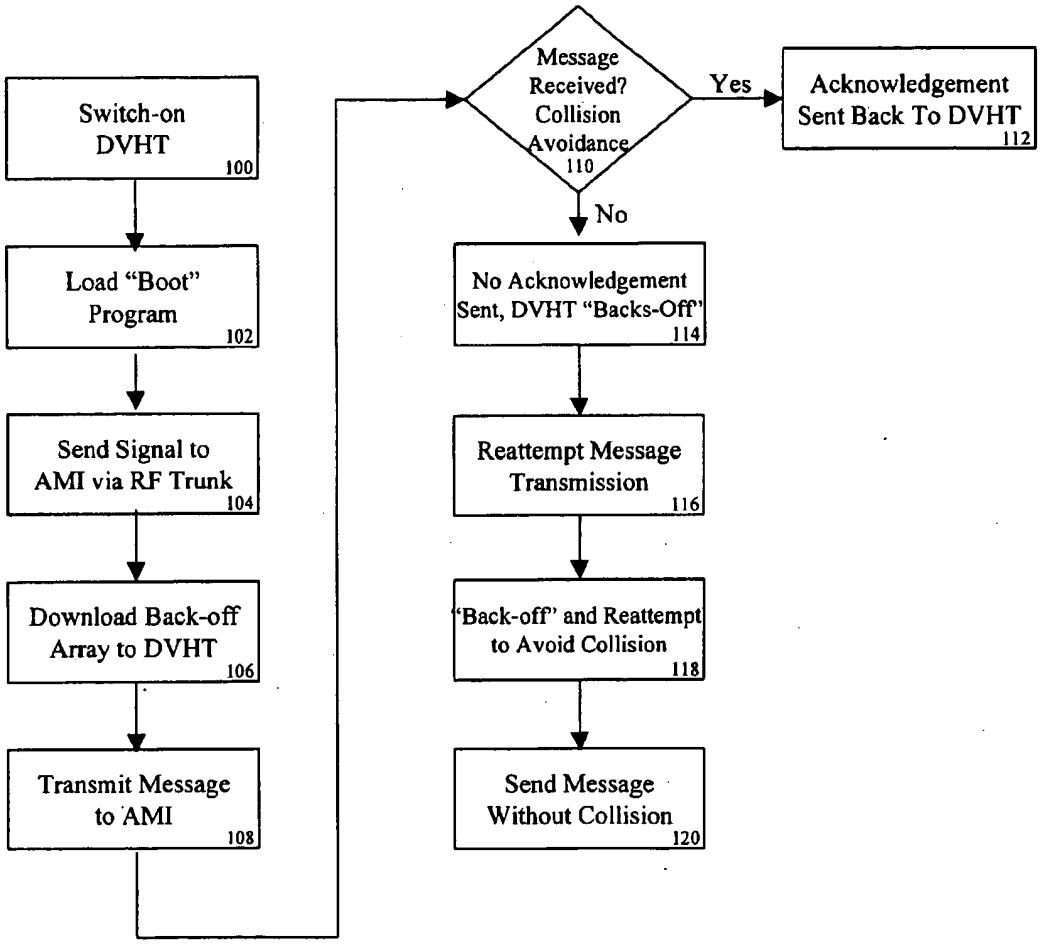

Switch-on DVHT
100
Load "Boot" Program
102
Send Signal to AMI via RF Trunk
104
Download Back-off Array to DVHT
106
Transmit Message to AMI
108
Message Received? Collision Avoidance
110
Yes
Acknowledgement Sent Back To DVHT
112
No
No Acknowledgement Sent, DVHT "Backs-Off"
114
Reattempt Message Transmission
116
"Back-off" and Reattempt to Avoid Collision
118
Send Message Without Collision
120

FIG. 3

SYSTEM AND METHOD OF BIDIRECTIONAL DIGITAL VIDEO COMMUNICATION OVER A CABLE

FIELD OF THE INVENTION

This invention relates to a system and method of bidirectional digital video communication over a cable that permits bidirectional communication between a cable headend and subscriber home terminals (e.g., Set-Top Boxes) with minimum message collisions.

BACKGROUND OF THE INVENTION

Cable television is becoming more popular and millions of homes use and receive analog cable signals from a cable supplier to watch favorite programs and in some instances receive other information. Typically, each subscriber has a Set-Top Box, (also referred to as a Home Terminal) that rests on the standard television and receives from the cable headend down-stream transmissions such television shows. The cable headend typically has a connection to a national programming supplier such as a television network.

Advances in communication are now making possible the use of digital video or EPPV/VOD products that allow cable suppliers to offer enhanced pay-per-view (EPPV) and video-on-demand (VOD) services while having a digital network solution. By using a digital network, the use of out-of-band signaling capabilities are now possible as well as video and audio transmission in both the uplink and downlink direction. It is now possible to have a digital video Set-Top Box or Digital Video Home Terminal that can receive down-stream transmissions and transmit upstream signals as necessary.

With the use of a digital network and RF Trunk, it is possible for hundreds of Digital Video Home Terminals to reside on one RF Trunk. With the use of hundreds of Digital Video Home Terminals that can generate a message upstream to the cable headend, it is possible for message collisions to occur when two or more Digital Video Home Terminals send a message about the same time, requesting video programming or other information and services. It is therefore necessary to design a system using Digital Video Home Terminals that avoids collisions with messages generated from various Digital Video Home Terminals located at different subscriber premises. Additionally, any solution to this problem should require little processing power and memory within the Digital Video Home Terminal or Set-Top Box to reduce the cost, size and complexity of Set-Top Box. To reduce the overall cost of the system to the subscriber, it is desirable that any major processing to avoid message collision be accomplished at the cable headend.

SUMMARY OF THE INVENTION

In accordance with the present invention, a cable system now permits bidirectional digital communication between a cable headend and a plurality of subscriber Digital Video Home Terminals each located at a different subscriber location such as a subscriber residence. The cable headend includes a processor for calculating and generating a randomized back-off array for each of the plurality of subscriber Digital Video Home Terminals. An RF Trunk line interconnects the cable headend and the plurality of subscriber home terminals so that messages from a subscriber can be sent to the cable headend and digital video or other information can be sent to the subscriber.

Each subscriber Digital Video Home Terminal includes a processor which receives from the cable headend a randomized back-off array for controlling when a Digital Video Home Terminal attempts to send a message to a cable headend and then reattempts to send the message a plurality of times after a random back-off interval of time has passed after each reattempt until no collision with another message is generated from a different home terminal.

In one aspect of the present invention, each Digital Video Home Terminal includes means for initializing communication with the cable headend when the randomized back-off array is received from the cable headend. In still another aspect of the present invention, a Digital Video Home Terminal includes Random Access Memory for storing the back-off array within the Random Access Memory of the Digital Video Home Terminal. The back-off array received from the cable headend allows reattempted message transmissions after a respective time-out period has elapsed that comprises a first randomized interval of time and then allows reattempted message transmission after another time-out period that comprises a second randomized interval of time. The first randomized interval of time is calculated from a uniformly distributed retry algorithm that is part of the back-off array and the second randomized period of time is calculated from an exponential period of time. The processor cable headend can also include circuitry for generating an acknowledgment to a subscriber Digital Video Home Terminal after the cable headend has received a message from the Digital Video Home Terminal. In an another aspect of the present invention the Digital Video Home Terminal is responsive whenever an acknowledgment is not received so that the Digital Video Home Terminal reattempts a message transmission to the cable headend pursuant to the random back-off interval of time. The trunk line interconnecting the cable headend and the plurality of subscriber Digital Video Home Terminals typically comprises an RF Trunk line.

BRIEF DESCRIPTION OF THE DRAWINGS

This invention and its mode of operation will be more clearly understood from the following detailed description when read with the appended drawings in which:

FIG. **1** shows a simplified block diagram of the general environment of the cable system allowing bidirectional digital video communication over a cable in accordance with the present invention.

FIG. **2** shows a more detailed view of a premises based Digital Video Home Terminal and the cable headend; and

FIG. **3** illustrates a flow chart showing one typical method in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to FIG. **1**, there is illustrated a cable system indicated generally at **10** and in accordance with the present invention that allows bidirectional digital video communication between a cable headend indicated generally at **12** and a plurality of different subscriber Digital Video Home Terminals (DVHT) **14** located at different subscriber locations such as a premises indicated by a dotted line **16** and in communication with the cable headend **12** via an RF Trunk **18**. In the illustrated embodiment, each RF Trunk **18** includes an RF Trunk Terminator **20** and a digital communication line **22** that connects the RF Trunk Terminator **20** to typically hundreds of different subscriber Digital Video Home Terminals **14**. In the illustrated embodiment, two RF Trunks **18**, **18'** are shown, and extend from the cable headend **12** to two RF Trunk Terminators **20**, **20'**.

The cable headend **12** typically includes an Administration and Maintenance Interface (AMI) **23** that includes the

processing power for generating randomized back-off arrays within its large central processing unit **24** and storage memory **26**. (FIG. **2**). Each DVHT **14** has its own back-off array, which the AMI **23** downloads to the DVHT **14**.

The AMI **23** can include a separate database **28** of different stored programs such as video programs that are then transmitted along the RF Trunk **18** to a subscriber premises **16** where the DVHT **14**, (typically a Set-Top Box) is situated on a television set **30**. The DVHT **14** and AMI **23** can uplink and download digital messages and other information such as Set-Top Provision Information, Set-Top Box Status and other billing information. Programs could also be downloaded, as well as status checks and alarms to and from the AMI **23** through the RF Trunk **18**. Some messages can include a request for a cable television program and even more complex requests or messages that allow the AMI **23** to access other databases such as national database **32** via communication network **34** or a nationally syndicated cable or television program from another cable network **36**.

Table 1 below shows a summary of various messages that can go into and out of the DVHT. The messages are divided into three functional areas:

a. Access Network OAM&P messages—these are the messages that are required to support the physical and logical functioning of the out-of-band message transport system. These messages are supported by the AMI and the Message Router.

b. Service OAM&P messages—these are messages that are required to support services in the DVHT such as software downloads, parameter provisioning and security messages. These messages are supported by the Server and the KMS.

c. Application Control and Support messages—these are messages to control and support the application (menus) running in the DVHT, such as purchase events, program termination requests, and motion control requests. These messages are supported by the Server.

TABLE 1

DVHT Message Summary

Access Network OAM&P Messages

Page # and Message Name	Direction	object_id	op_code	Comments/Addressing Mode if not HDLC point-to-point
34 PING	AMI>DVHT(MAINT)	8192	1	
35 SET_FREQ	AMI>DVHT(MAINT)	8192	2	Set RF Frequency
36 SET_POWER	AMI>DVHT(MAINT)	8192	3	Set RF Modem Power
37 SET_ALOHA_PARMS	AMI>DVHT(MAINT)	8192	4	Set Aloha Retry Parameters
38 SET_MSG_SEQ	AMI>DVHT(MAINT)	8192	5	Set Message Sequence Number
39 SET_HDLC_ADDR	AMI>DVHT(MAINT)	8192	7	Sets DVHT HDLC address
40 MODEM_ON	AMI>DVHT(MAINT)	8192	9	Enable/Disable RF Modem
41 POWER_CAL	MR>DVHT(MAINT)	8192	10	Start/stop power calibration flags
43 CLEAR_ERRORS	AMI>DVHT(MAINT)	8192	12	
44 ATT_PROVISION	AMI>DVHT(MAINT)	8192	13	AMI Registration message HDLC broadcast address with DVHT_ID match
46 GET_DVHT_MAKEMODEL	AMI>DVHT(MAINT)	8192	14	Get DVHT ID HDLC broadcast address with DVHT_ID match
47 GET_STATUS	AMI>DVHT(MAINT)	8192	15	To locate a DVHT
49 UNREGISTER	AMI>DVHT(MAINT) Server (SMS) >DVHT(MAINT)	8192	16	Set the DVHT to its unregistered state
50 SOFT_BOOT	AMI>DVHT(MAINT) Server (SMS) >DVHT(MAINT)	8192	20	Reset DVHT parameter, but retain its registration parameters.
51 SET_FRAG_PARMS	AMI>DVHT(MAINT)	8192	21	Set Fragmentation Parameters
52 CLEAR_DIAG_ERRORS	AMI>DVHT(MAINT)	8192	24	Clear diagnostic errors
53 FIND_DVHT	AMI>DVHT(MAINT)	8192	25	Find DVHT with matching dvht_id, HDLC broadcast address with DVHT_ID match
55 GENERICREPLY	DVHT(MAINT)>AMI	echo	echo	
56 PINGREPLY	DVHT(MAINT)>AMI	8192	echo	
57 GET_DVHT_MAKEMODEL-REPLY	DVHT(MAINT)>AMI	8192	echo	Contains DVHT Make, Model number, IP address, and idle address
58 GET_STATUSREPLY	DVHT(MAINT)>AMI DVHT(MAINT)>MSGRTR	8192	echo	Contains DVHT status
62 FIND_DVHTREPLY	DVHT(MAINT)>AMI	8192	echo	Returns matching DVHT_ID

Page # and Message Name	Direction		op_code	Comments
		Service OAM&P Messages		
64 KMSGET_PUBKEY	KMS>DVHT(CRYPT)	4096	1	KMS registration data
65 NEWUEV	KMS>DVHT(CRYPT)	4096	2	Update the UEV
66 REKEY	KMS>DVHT(CRYPT)	4096	3	Change the keys
68 KMSGET_PUBKEYREPLY	DVHT(CRYPT)>KMS	4096	echo	
69 NEWUEVREPLY	DVHT(CRYPT)>KMS	4096	echo	
70 REKEYREPLY	DVHT(CRYPT)>KMS	4096	echo	
72 RTE_CLEARPINS	Server(SMS)>DVHT(RTE)	1	1	Clear the PINs
73 RTE_SETFLAGS	Server(SMS)>DVHT(RTE)	1	2	Set/Clear RTE flags
74 RTE_STATUS	Server(NMS)>DVHT(RTE)	1	3	Get the RTE Status
75 RTE_SETENV	Server(ASM)>DVHT(RTE)	1	4	Set RTE environment variables
77 RTE_PROVISION	Server(REG)>DVHT(RTE)	1	5	Load RTE provisioning data

TABLE 1-continued

DVHT Message Summary				
79 IR_PROVISION	Server (Reg)>DVHT(REG)	16384	4	Provision IR Blaster Codes
80 SYSPROVISION	Server (Reg)>DVHT(REG)	16384	3	Set provisioned system variables
81 DOWNLOAD_EXECUTE	Server (UPD)>DVHT(UPG)	12288	2	Download new SW image
83 DOWNLOAD_EXECUTE_REPLY	DVHT(UPG)>Server(UPD)	12288	echo	
84 DOWNLOAD_PREPARE	Server(REG)>DVHT(UPG)	12288	1	
85 DOWNLOAD_PREPARE_REPLY	DVHT(UPG)>Server(UPD)	12288	echo	
87 SET_IP_ADDR	Server(REG)>DVHT(MAINT)	8192	8	Set DVHT In-Band IP address
89 RTESTATUSREPLY	DVHT(RTE)>Server(NMS)	1	echo	
Application Support Messages, Out-of-Band				
92 ASPRESP	Server(ASM)>DVHT(APP)	2	echo	Response to Application Request
93 ASPBUYRESP	Server(ASM)>DVHT(APP)	2	echo	Response to Buy Request
94 ASPPVURESP	Server(ASM)>DVHT(APP)	2	echo	Response to Pre-view Request
97 ASPBUYREQ	DVHT(APP)>Server(ASM)	2	1	Program Buy Request
98 ASPTERMREQ	DVHT(APP)>Server(ASM)	2	2	Program Terminate Request
100 ASPMCREQ	DVHT(APP)>Server(ASM)	2	3	Motion Control Request
101 ASPRTREQ	DVHT(APP)>Server(ASM)	2	4	Program Restart Request
104 ASPPVUREQ	DVHT(APP)>Server(ASM)	2	5	Pre-view Report
Application Support Messages, In-Band				
106 Application Tables Types	Server(ADM)>DVHT(APP)	var	1	Directory of broadcast media and data with RF tuning and PID info
110 Application List Table (ALT)	Server(ADM)>DVHT(APP)	var	2	Tabular information supporting hierarchical APP menu structure

It is evident that the type of messages can vary widely, including Frequency and Modem information (as known to those skilled in the art); Retry parameters; Digital Address information; Modem Enable and Disable commands; Power calibration; Registration messages; Diagnostic checks; Model information and addresses; PINs for security; images of products and advertisements; accounting; and Pay-per-view matters.

In accordance with one aspect of the invention, the DVHT **14** includes a processor (e.g., central processing unit) **38** and Random Access Memory (RAM) **40** connected to the processor (FIG. **2**). Also, Read Only Memory (ROM) **42** has a boot program **43** that is operable when the DVHT **14** is initially turned on. The boot program **43** loads and allows the first part of an initialization of the DVHT **14** with the AMI **23**. During the initialization of the DVHT **14**, the AMI **23** then transmits along the RF Trunk **18** to the initializing DVHT **14** the particular back-off array used for controlling the DVHT's attempts and reattempts in sending messages to the AMI **23** without collision with other messages from another subscriber DVHT. This "Boot" program **43** allows registration of the DVHT **14** with the AMI **23**.

At the time that a DVHT **14** is registered within the AMI **23** of the cable system **10**, the DVHT has been initialized with a randomized back-off array. This approach consolidates back-off algorithm administration and more readily allows for future requirements regarding upstream congestion control such as when numerous DVHT's are sending messages at one time. In addition, this solution saves on DVHT memory and cost because large processing and memory units will not be necessary in a DVHT **14**.

This random back-off will consist of two algorithms:

1. A quick, uniformly distributed retry algorithm will be used for the first 5 retries and is defined as:
   wait_on_aloha_ack_interval+iuniform[0–100 ms]
2. An exponential retry algorithm will be used for the last 5 retries and is defined as:
   wait_on_aloha_ack_interval+2 **#retries*iuniform [0–1,000 ms]
   (taking into account the number of collisions, i.e., the larger the number of collisions, the longer the random back-off interval)

The array that is sent to the DVHT at the time of initialization will consist of 11 three-byte shorts. Each row entry maps to a retry time-out interval in milliseconds.

The back-off array will be defined as:

Row 0—0th retry: wait_on_aloha_ack_interval+ iuniform[0–50]

Row 1—1st retry: wait_on_aloha_ack_interval+ iuniform[0–50]

Row 5—5th retry: wait_on_aloha_ack_interval+ iuniform[0–50]

Row 6—6th retry: wait_on_aloha_ack_interval+2**6* iuniform[0–1,000] Row 7—7th retry: wait_on_ aloha_ack_interval+2**7* iuniform[0–1,000]

Row 10—10th retry:. wait_on_aloha_ack_interval+ 2**10* iuniform[0–1,000]

In reattempting message transmissions, typically, the first set of message transmissions are reattempted after a respective time-out. That is a first randomized interval of time such as between 0 to 100 milliseconds. After these first reattempts, the DVHT then reattempts message transmission after a respective time-out. That is a second randomized interval of time such as between 0 to 1,000 milliseconds. The randomized interval of time can be calculated from a uniformly distributed retry algorithm and the second randomized interval of time can be calculated from exponential retry algorithm.

Each row entry is a 16 bit number representing time in milliseconds.

It is evident that this randomization function is now done at the cable headend **12** instead of a more traditional method where randomization is accomplished by the entity that is transmitting the messages in traffic (e.g., in the present invention the DVHT **14**). However, as noted before, the DVHT **14** (Set-Top Box) should have minimal memory and CPU needs in order to reduce the cost and complexity of the unit. Thus, the DVHT will be more attractive for use by subscribers such as typically found in a one family household.

FIG. **3** illustrates a flow chart showing one basic high level method of operation of the present invention. At the

outset, the subscriber "switches-on" the DVHT **14** (Block **100**) and begins the initialization process. A "boot" program loads (Block **102**) and a signal is sent by the DVHT **14** through the RF Trunk Terminator **20** and RF Trunk **18** to the AMI (Block **104**) to signal the AMI to transmit the randomized back-off array to the DVHT **14**. The AMI **23** then forwards the back-off array to the RAM **40** of the DVHT (Block **106**). A message is then transmitted by the DVHT **14** to the AMI (Block **108**). If the AMI **23** receives the message (Block **110**), an acknowledgement is sent back to the DVHT **14** (Block **112**) and a cable movie or other information may follow.

If an acknowledgement is not received back by the DVHT (Block **114**), the DVHT then backs-off a first randomized interval of time and then reattempts the message transmission (Block **116**). If a collision is imminent again, the DVHT backs off again and then reattempts transmission based on randomized intervals of time between "0" and some time period (Block **118**). The first random interval of time could be between 0 and 100 milliseconds. After about five tries, the random period of time could then be extended to as high as 0 to 1,000 milliseconds. At that time, no collisions should be imminent and a message transmitted without collision (Block **120**). Waiting time, however, could be excessive by the time the sixth, seventh or eighth retry occurs.

It is evident that the present invention now provides a digital video and enhanced pay-per-view and video-on-demand service that accommodates a collision based network. The overall cost of a DVHT used in a premises is reduced by the use of having the cable headend calculate a back-off array for controlling a Digital Video Home Terminal.

What has been described as merely illustrative of present invention. Other applications other than the disclosed system the method or contemplated as being within the knowledge one skilled in the art may be utilized without departing from the spirit and scope of the present invention.

That which is claimed is:

1. A method of bidirectional digital communication over cable comprising the step of:

receiving, in response to an initialization signal, within each of a plurality of different subscriber digital video home terminals located at different subscriber locations and in communication with a cable headend a randomized back-off array for controlling when a subscriber digital video home terminal attempts to send a message to the cable headend and then reattempts to send the message a plurality of times after a random back-off interval of time has passed after each reattempt until no collision would occur with another message generated from another subscriber home terminal, the randomized back-off array being generated at the cable headend with a two-stage back-off retry algorithm.

2. A method according to claim **1** including the step of generating the randomized back-off array at the cable headend and initializing the digital video home terminal with the randomized back-off array so that the digital video home terminal can establish communication with the cable headend.

3. A method according to claim **1** including the step of storing the back-off array within a Random Access Memory of the digital video home terminal.

4. A method according to claim **1** including the step of reattempting message transmissions after a respective time-out period that is a first randomized interval of time and then reattempting message transmissions after a respective time-out period that is a second randomized interval of time.

5. A method according to claim **1** wherein the first randomized interval of time is calculated from a uniformly distributed retry algorithm and the second randomized interval of time is calculated from an exponential retry algorithm.

6. A method according to claim **1** including the step of reattempting to send a message if an acknowledgement of message receipt is not received from the cable headend.

7. A method of bidirectional digital communication along a cable comprising the steps of:

initializing communication with a cable headend by booting a subscriber digital video home terminal located at a subscriber premises and receiving from the cable headend a randomized back-off array that is used to calculate random back-off intervals of time, the randomized back-off array being generated at the cable headend with a two-stage back-off retry algorithm,

attempting to send a message to the cable headend and backing-off from sending the message if a collision with another message generated from a different subscriber digital video home terminal would occur, and

reattempting to send the message a plurality of times after a random back-off interval of time has passed until no collision would occur with another message generated from a different home terminal.

8. A method according to claim **7** including the step of generating the back-off array at the cable headend.

9. A method according to claim **7** including the step of storing the back-off array within a Random Access Memory of the digital video home terminal.

10. A method according to claim **7** including the step of reattempting to send a message if an acknowledgement is not received from the cable headend.

11. A method according to claim **7** including the step of reattempting message transmissions after a respective time-out period that is a first randomized interval of time and then reattempting message transmissions after a respective time-out period that is a second randomized interval of time.

12. A method according to claim **7** wherein the first randomized interval of time is calculated from a uniformly distributed retry algorithm and the second randomized interval of time is calculated from an exponential retry algorithm.

13. A cable system that permits bidirectional digital communication along a cable with minimum message collisions comprising:

a plurality of subscriber digital video home terminals each located at a different subscriber location,

a cable headend having a processing means for calculating and storing a randomized back-off array for each of the plurality of subscriber home terminals, wherein the randomized back-off array is generated with a two-stage back-off retry algorithm,

a trunk line interconnecting the cable headend and the plurality of subscriber digital video home terminals through which messages from a subscriber can be sent to the cable headend and digital video can be sent to the subscriber,

and wherein each subscriber digital video home terminal includes means for receiving a randomized back-off array from the cable headend for controlling when a digital video home terminal attempts to send a message to the cable headend and then reattempts to send the message a plurality of times after a randomized back-off interval of time has passed after each reattempt until no collision would occur with another message generated from a different digital video home terminal.

14. A system according to claim **13** wherein each digital video home terminal includes means for initializing com-

munication with the cable headend when the randomized back-off array is received from the cable headend.

15. A system according to claim 13 wherein a digital video home terminal includes Random Access Memory for storing the back-off array within the Random Access Memory of the digital video home terminal.

16. A system according to claim 13 wherein the back-off array received from the cable headend allows reattempted message transmissions after a respective time-out interval that comprises a first randomized interval of time and then allows reattempted message transmissions after a respective time-out period that comprises a second randomized interval of time.

17. A system according to claim 13 wherein the first randomized interval of time is calculated from a uniformly distributed retry algorithm and the second randomized interval of time is calculated from an exponential period of time.

18. A system according to claim 13 wherein said processor at the cable headend includes means for generating an acknowledgement to a subscriber digital video home terminal after the cable headend has received a message from the digital video home terminal.

19. A system according to claim 13 wherein said digital video home terminal includes means responsive to when an acknowledgement is not received so that a digital video home terminal reattempts a message transmission to the cable headend pursuant to a calculated random back-off interval of time.

20. A system according to claim 13 wherein said trunk line interconnecting the cable headend and the plurality of subscriber digital video home terminals comprises an RF Trunk line.

* * * * *

US005966636A

United States Patent [19]

Corrigan et al.

[11] Patent Number: 5,966,636

[45] Date of Patent: Oct. 12, 1999

[54] **METHOD AND APPARATUS FOR MULTIPLE ACCESS OVER RANDOMIZED SLOTS WITH COLLISION DETECTION IN A CABLE TELEPHONY SYSTEM**

[75] Inventors: **Richard Corrigan**, LaGrange; **Bruce D. Mueller**, Palatine; **Timothy M. Burke**, Algonquin, all of Ill.

[73] Assignee: **Motorola, Inc.**, Schaumburg, Ill.

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[51] **Int. Cl.**[6] **H04N 7/16**

[52] **U.S. Cl.** **455/4.2**; 348/10; 348/12; 348/13

[58] **Field of Search** 455/4.1, 4.2, 5.1, 455/6.2, 6.3; 348/13, 12, 9, 4

[56] **References Cited**

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5,517,502	5/1996	Bestler et al.	455/6.2
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OTHER PUBLICATIONS

Generic Criteria for Version 0.1 Wireless Access Communications Systems (WACS) published by Bellcore, 1993 (TR-INS-001313), specifically Sections 6.4.5. and 6.5.2.

Personal Access Communications System Air Interface Standard J-STD-014 (PACS) published by Technical Ad Hoc Group 3 of the T1/TIA Joint Technical Committee, specifically Sections 6.4.5. and 6.5.2.

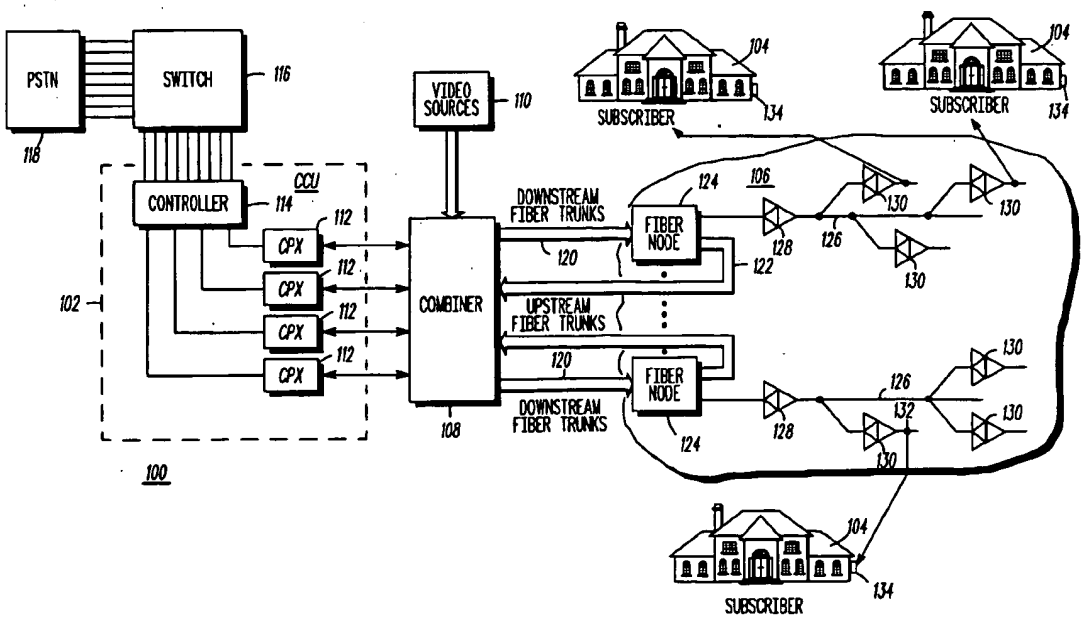
Primary Examiner—Anand S. Rao

Attorney, Agent, or Firm—Hugh C. Dunlop

[57] **ABSTRACT**

A method and apparatus in a communications system (**100**) for providing communications units (**134**) access to the communications system (**100**). The communications. system (**100**) includes a cable distribution network (**106**) with an base communications unit (**102**) and a number of downstream communications units (**134**) all connected to the cable distribution network (**106**). A plurality of channels are used to transmit data between the base communications unit (**102**) and the downstream communications units (**134**). A first set of channels are used primarily for access the communications system (**100**) and a second set of channels are used for transmitting data within the communications system (**100**) after access to the communications system (**100**) has been gained. The base communications unit (**102**) sends a first type of data transmission including an identification of access channels used for requesting access to the communications system (**100**). The base communications unit (**102**) assigns channels within the second set of channels response to receiving a request for access to the communications system (**100**) on the first set of channels. A mechanism also is provided for handling collisions in transmissions between the downstream communications units (**134**) to the base communications unit (**102**) in attempting to gain access to the communications system (**100**).

30 Claims, 16 Drawing Sheets



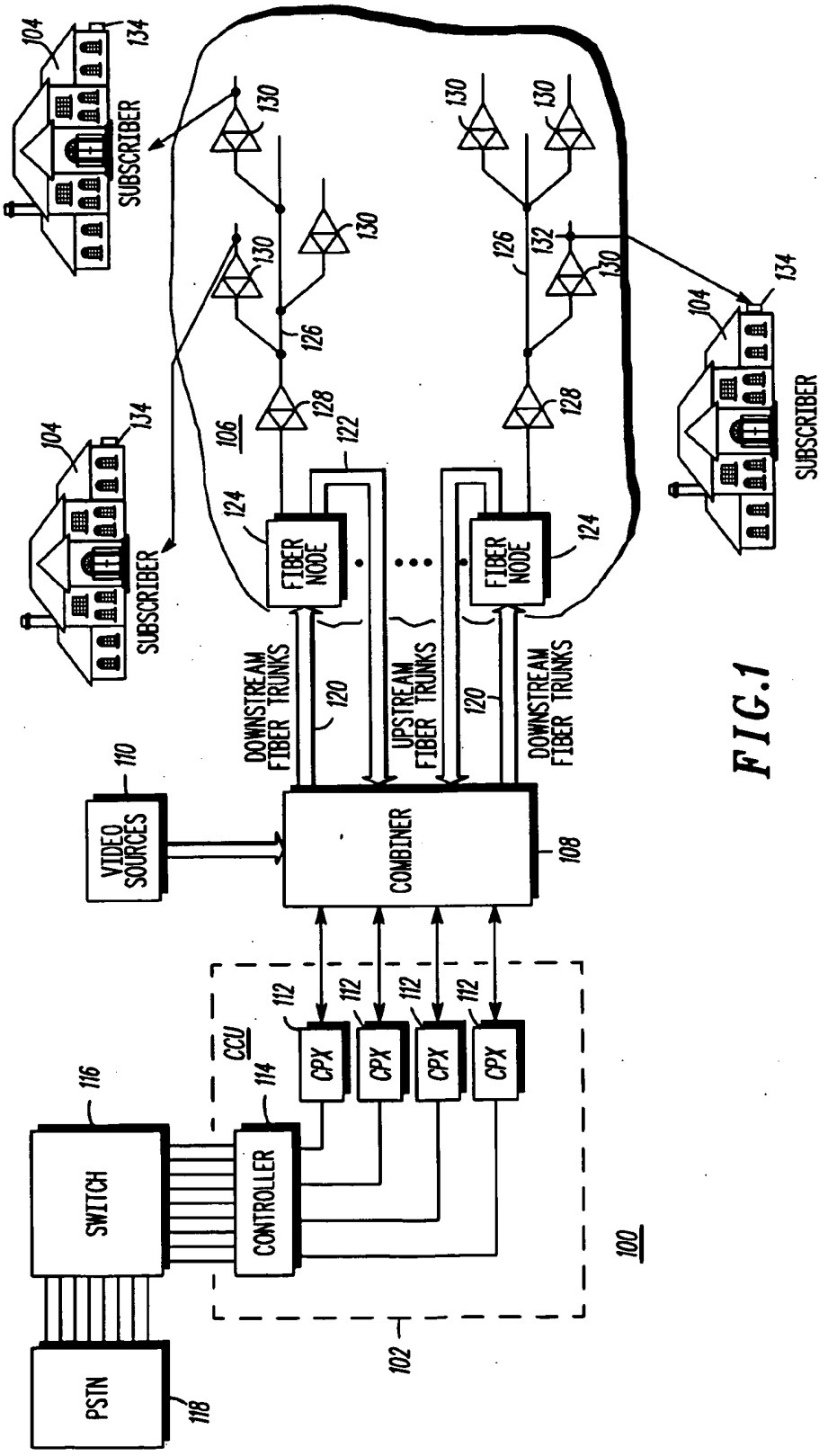

SUBSCRIBER
SUBSCRIBER
SUBSCRIBER
FIBER NODE
FIBER NODE
DOWNSTREAM FIBER TRUNKS
UPSTREAM FIBER TRUNKS
DOWNSTREAM FIBER TRUNKS
VIDEO SOURCES
COMBINER
CPX
CPX
CPX
CPX
CCU
SWITCH
CONTROLLER
PSTN
100
102
104
106
108
110
112
114
116
118
120
122
124
126
128
130
132
134

FIG.1

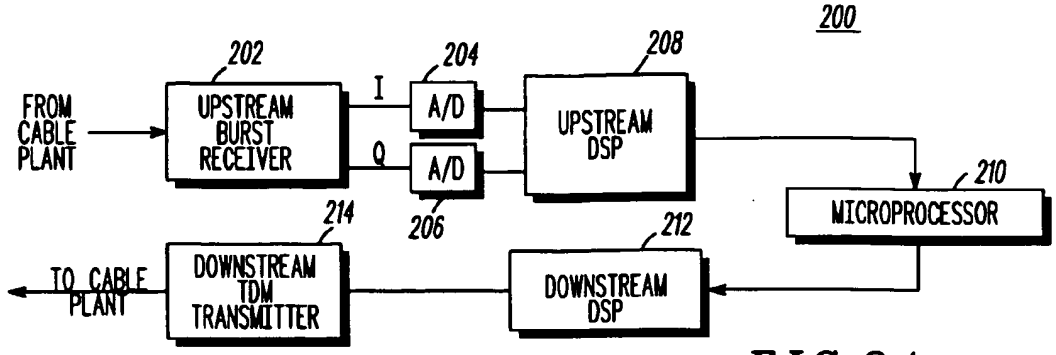

200
202
204
208
FROM CABLE PLANT
UPSTREAM BURST RECEIVER
I
Q
A/D
A/D
UPSTREAM DSP
210
MICROPROCESSOR
214
206
212
TO CABLE PLANT
DOWNSTREAM TDM TRANSMITTER
DOWNSTREAM DSP

FIG.2A

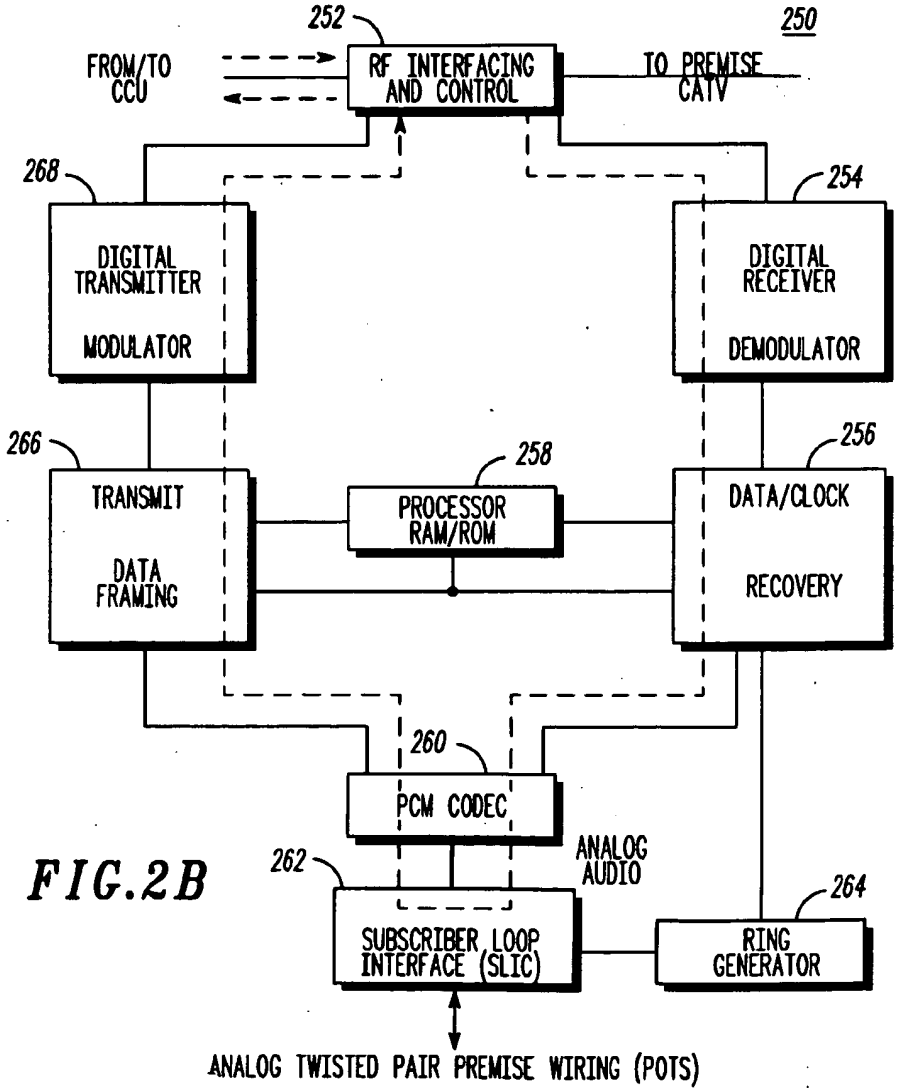

252
250
FROM/TO CCU
RF INTERFACING AND CONTROL
TO PREMISE CATV
268
254
DIGITAL TRANSMITTER MODULATOR
DIGITAL RECEIVER DEMODULATOR
266
258
256
TRANSMIT DATA FRAMING
PROCESSOR RAM/ROM
DATA/CLOCK RECOVERY
260
PCM CODEC
ANALOG AUDIO
262
264
SUBSCRIBER LOOP INTERFACE (SLIC)
RING GENERATOR
ANALOG TWISTED PAIR PREMISE WIRING (POTS)

FIG.2B

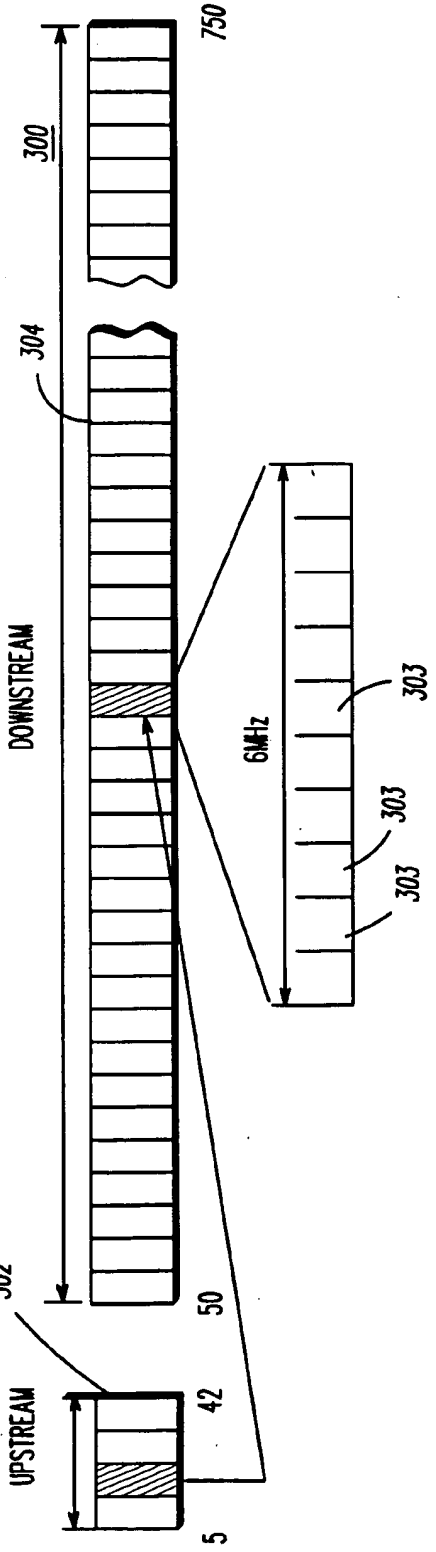

750
300
304
DOWNSTREAM
6MHz
303
303
303
302
UPSTREAM
50
42
5

FIG.3

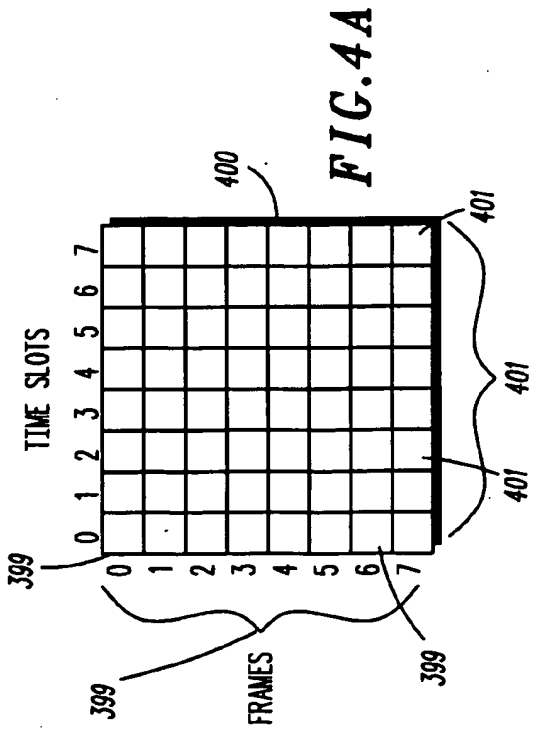

400
401
401
401
TIME SLOTS
0 1 2 3 4 5 6 7
399
0 1 2 3 4 5 6 7
399
FRAMES
399

FIG.4A

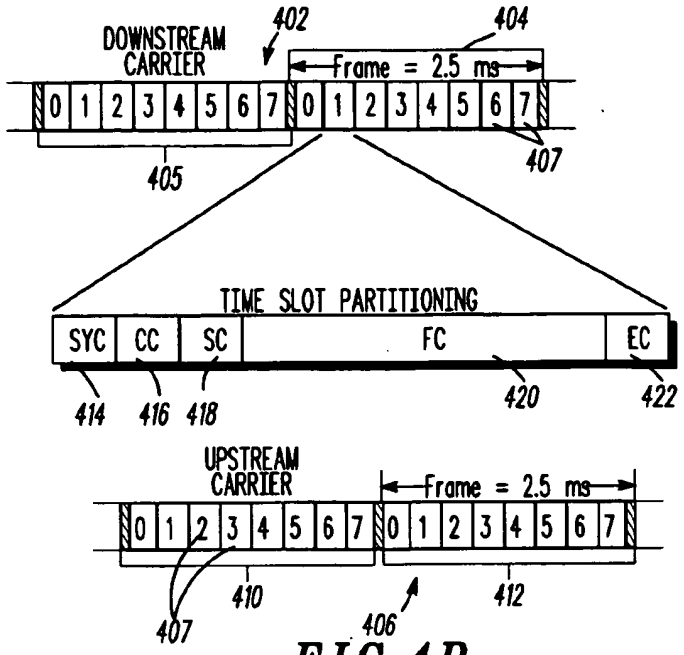


FIG.4B

ACCESS REQUEST NUMBER (ARN)

BITS								RELATIVE OCTET
8	7	6	5	4	3	2	1	
ALERT VALUE (8 - 1)								1
ALERT PHASE				ALERT VALUE(12 - 9)				2
RANDOM NUMBER								3

500

FIG.5A

SHORTENED UPLINK BURST (SUB)

BITS								SUB OCTET
8	7	6	5	4	3	2	1	
DE								1
SYNCHRONIZATION PATTERN								2 3 4
SYNCHRONIZATION PATTERN								5 6 7
SYNCHRONIZATION PATTERN								8 9 10
ACCESS REQUEST NUMBER (ARN)								11 12 13

502

FIG.5B

SYNCHRONIZATION PATTERN

BITS								SUB
8	7	6	5	4	3	2	1	OCTET
1	1	1	1	1	0	0	0	1
1	1	0	0	1	0	1	0	2
0	0	0	0	0	1	0	1	3

504

FIG.5C

TIME ALIGMENT RESPONSE

BITS								FC
8	7	6	5	4	3	2	1	OCTET
1	1	0	0	0	1	0	1	1
ACCESS REQUEST NUMBER (ARN)								2
								3
								4
TIME ALIGMENT VALUE								5
PCI	POWER ADJUSTMENT VALUE							6

504

FIG.5D

INITIAL ACCESS REQUEST, FAST CHANNEL

BITS								FC
8	7	6	5	4	3	2	1	OCTET
0	0	1	1	1	0	0	1	1
ACCESS REQUEST NUMBER (ARN)								2
								3
								4
MAXIMUM BANDWIDTH RATE				MINIMUM BANDWIDTH RATE				5

508

FIG.5E

INITIAL ACCESS REQUEST, SLOW CHANNEL

BITS								SC
8	7	6	5	4	3	2	1	OCTET
0	1							1
ACCESS REQUEST RATE				ARN			0	2
RESERVED								3
								4

510

FIG.5F

RECONNECT ACCESS REQUEST

512

BITS								FC
8	7	6	5	4	3	2	1	OCTET
1	1	0	0	0	0	1	0	1
ACCESS REQUEST NUMBER (ARN)								2
								3
								4
RES.	UPLINK CARRIER ID							5
RES.	DOWNLINK CARRIER ID							6
FLAG	TIME SLOT A			BANDWIDTH A				7
FLAG	TIME SLOT B			BANDWIDTH B				8
FLAG	TIME SLOT C			BANDWIDTH C				9
FLAG	TIME SLOT D			BANDWIDTH D				10
FLAG	TIME SLOT E			BANDWIDTH E				11
FLAG	TIME SLOT F			BANDWIDTH F				12
FLAG	TIME SLOT G			BANDWIDTH G				13
FLAG	TIME SLOT H			BANDWIDTH H				14

FIG.5G

ACCESS CONFIRM RESPONSE, FAST CHANNEL

514

BITS								FC
8	7	6	5	4	3	2	1	OCTET
1	1	0	0	0	1	1	0	1
ACCESS REQUEST NUMBER (ARN)								2
								3
								4
RES.	UPLINK CARRIER ID							5
RES.	DOWNLINK CARRIER ID							6
FLAG	TIME SLOT			BANDWIDTH				7
(CONTINUE AS NEEDED)								UP TO
FLAG	TIME SLOT			BANDWIDTH				14

FIG.5H

ACCESS CONFIRM RESPONSE, SLOW CHANNEL

BITS								SC
8	7	6	5	4	3	2	1	OCTET
0	1							5
BANDWIDTH				0	0	1	1	6
		ARN			TIME SLOT			7
RESERVED								8

516

FIG.5I

ACCESS DENY REPONSE, FAST CHANNEL

BITS								
8	7	6	5	4	3	2	1	OCTET
1	1	1	0	1	1	1	1	1
ACCESS REQUEST NUMBER (ARN)								2
								3
								4
CAUSE								5

518

FIG.5J

ACCESS DENY REPONSE, SLOW CHANNEL

BITS								SC
8	7	6	5	4	3	2	1	OCTET
0	1							3
1	1	1	0	1	1	1	1	4
RESERVED					ARN			5
CAUSE VALUE								6

520

FIG.5K

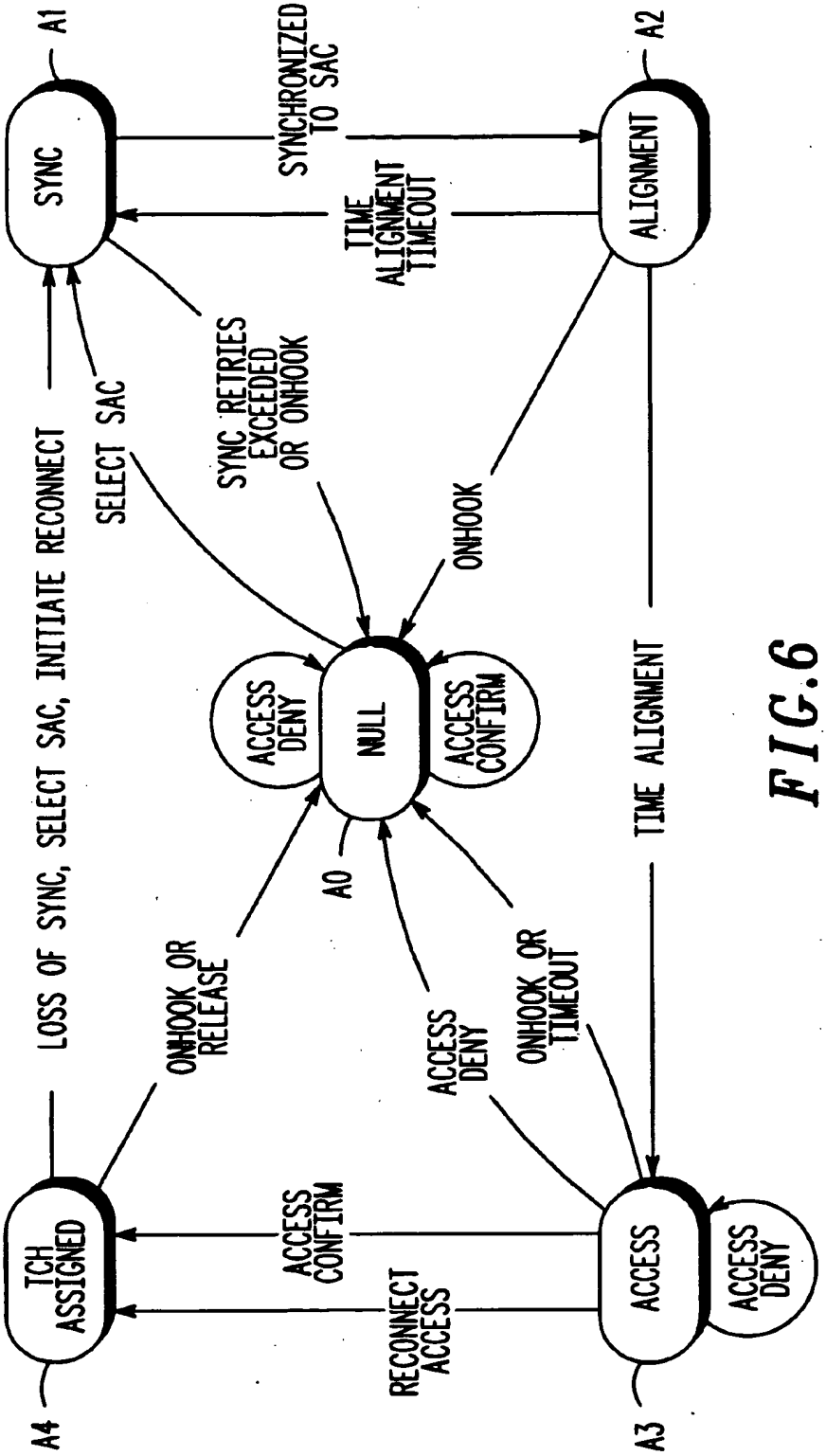

A1
SYNC
SYNCHRONIZED TO SAC
A2
ALIGNMENT
TIME ALIGNMENT TIMEOUT
SELECT SAC
SYNC RETRIES EXCEEDED OR ONHOOK
ONHOOK
LOSS OF SYNC, SELECT SAC, INITIATE RECONNECT
ACCESS DENY
NULL
ACCESS CONFIRM
A0
TIME ALIGNMENT
ONHOOK OR RELEASE
ACCESS DENY
ONHOOK OR TIMEOUT
ICH ASSIGNED
ACCESS CONFIRM
ACCESS
ACCESS DENY
RECONNECT ACCESS
A4
A3

FIG.6

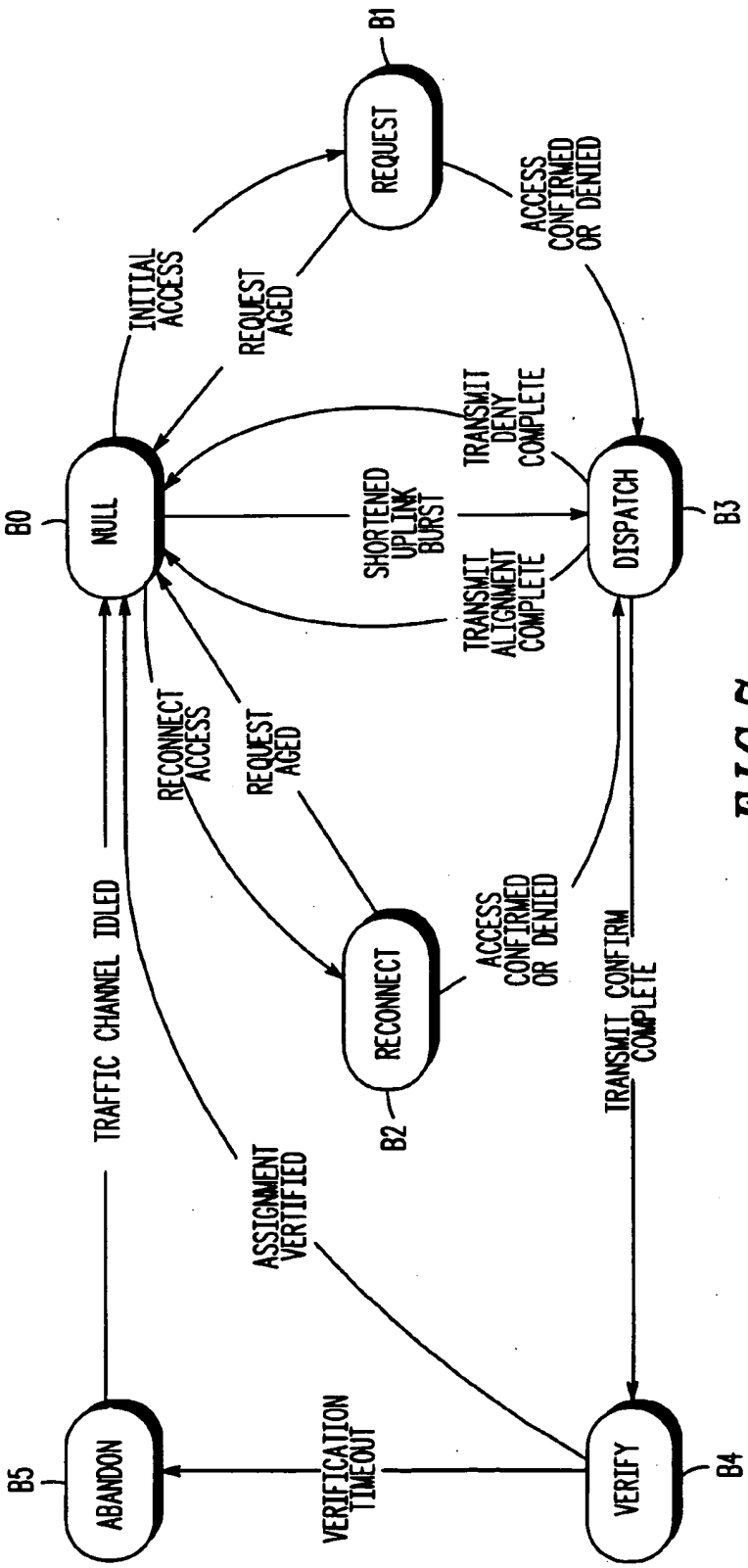

B1
REQUEST
ACCESS CONFIRMED OR DENIED
INITIAL ACCESS
REQUEST AGED
TRANSMIT DENY COMPLETE
B0
NULL
SHORTENED UPLINK BURST
DISPATCH
B3
TRANSMIT ALIGNMENT COMPLETE
RECONNECT ACCESS
REQUEST AGED
ACCESS CONFIRMED OR DENIED
TRAFFIC CHANNEL IDLED
RECONNECT
B2
TRANSMIT CONFIRM COMPLETE
ASSIGNMENT VERTIFIED
B5
ABANDON
VERIFICATION TIMEOUT
VERIFY
B4

FIG.7

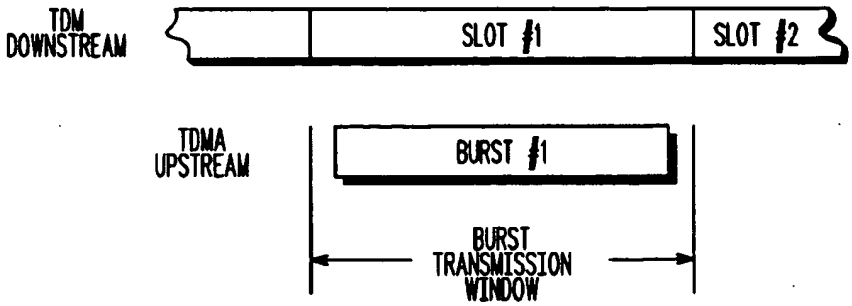

TDM DOWNSTREAM
SLOT #1
SLOT #2
TDMA UPSTREAM
BURST #1
BURST TRANSMISSION WINDOW

FIG.8

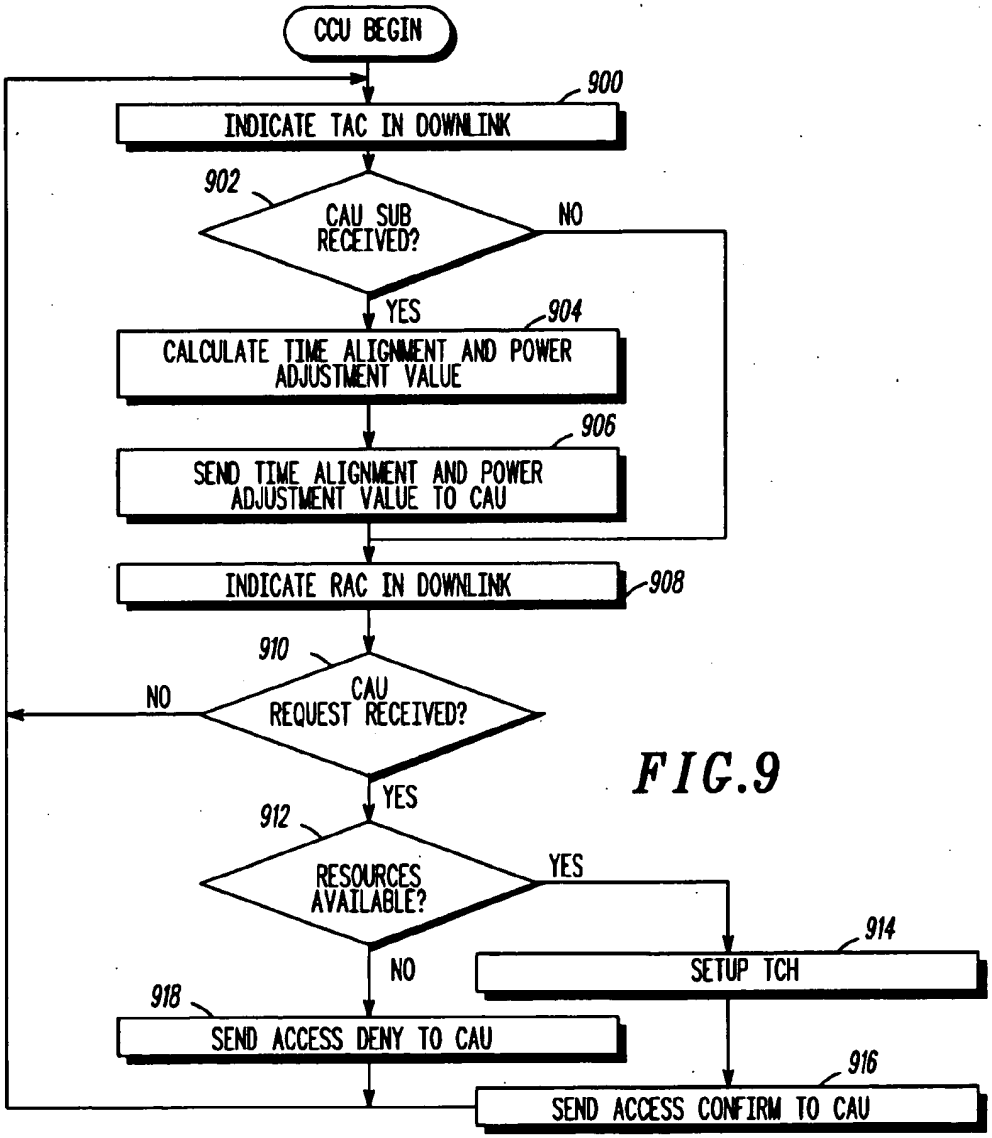

CCU BEGIN
900
INDICATE TAC IN DOWNLINK
902
CAU SUB RECEIVED?
NO
YES
904
CALCULATE TIME ALIGNMENT AND POWER ADJUSTMENT VALUE
906
SEND TIME ALIGNMENT AND POWER ADJUSTMENT VALUE TO CAU
INDICATE RAC IN DOWNLINK
908
910
CAU REQUEST RECEIVED?
NO
YES
912
RESOURCES AVAILABLE?
YES
NO
914
SETUP TCH
918
SEND ACCESS DENY TO CAU
916
SEND ACCESS CONFIRM TO CAU

FIG.9

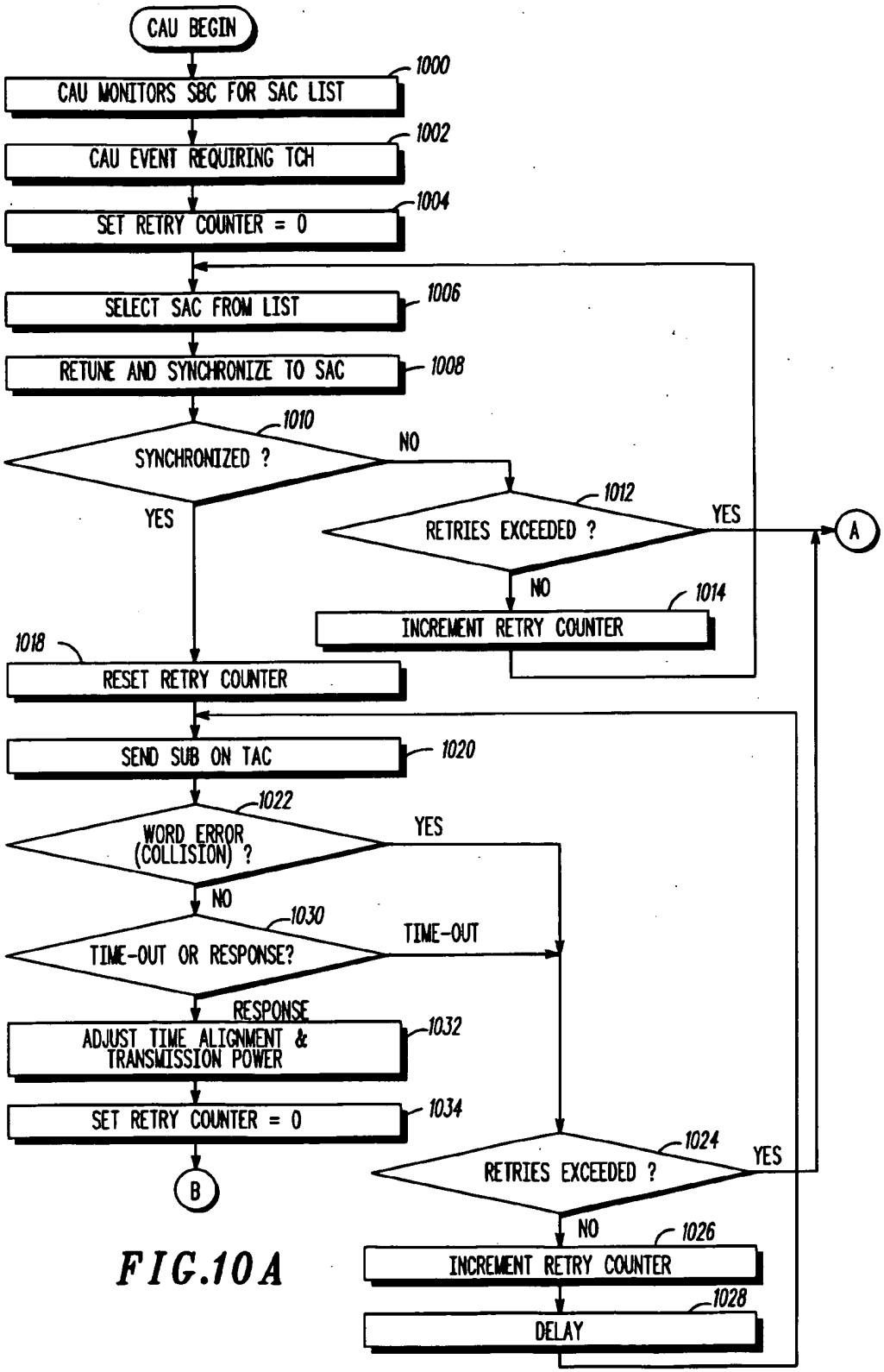

CAU BEGIN
1000
CAU MONITORS SBC FOR SAC LIST
1002
CAU EVENT REQUIRING TCH
1004
SET RETRY COUNTER = 0
1006
SELECT SAC FROM LIST
1008
RETUNE AND SYNCHRONIZE TO SAC
1010
SYNCHRONIZED ?
NO
YES
1012
RETRIES EXCEEDED ?
YES
A
NO
1014
INCREMENT RETRY COUNTER
1018
RESET RETRY COUNTER
1020
SEND SUB ON TAC
1022
WORD ERROR (COLLISION) ?
YES
NO
1030
TIME-OUT OR RESPONSE?
TIME-OUT
RESPONSE
1032
ADJUST TIME ALIGNMENT & TRANSMISSION POWER
1034
SET RETRY COUNTER = 0
B
1024
RETRIES EXCEEDED ?
YES
NO
1026
INCREMENT RETRY COUNTER
1028
DELAY

FIG.10A

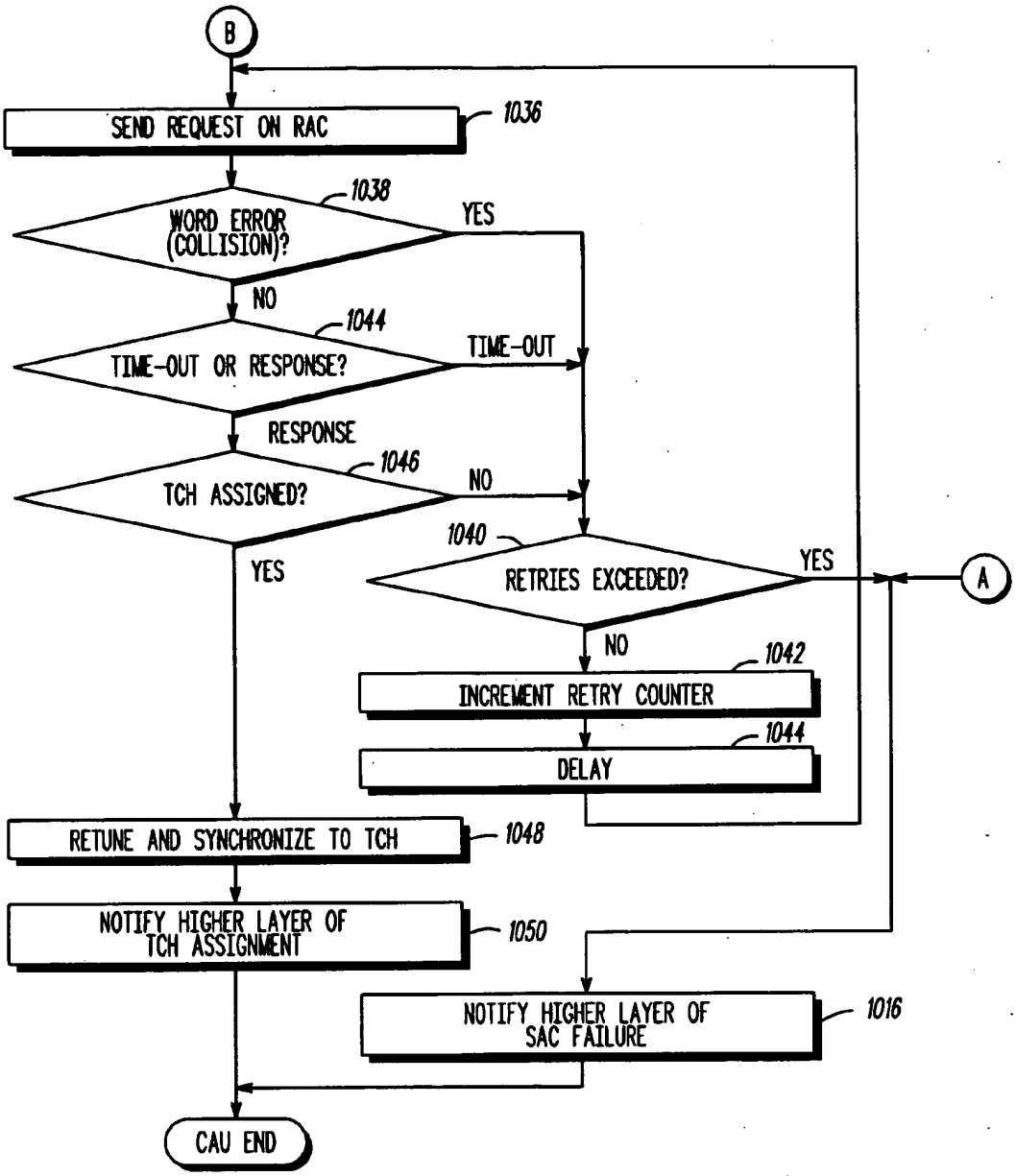


FIG.10B

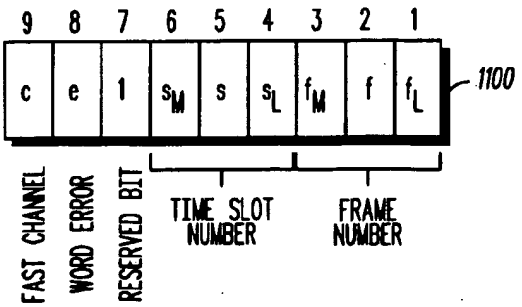


FIG.11

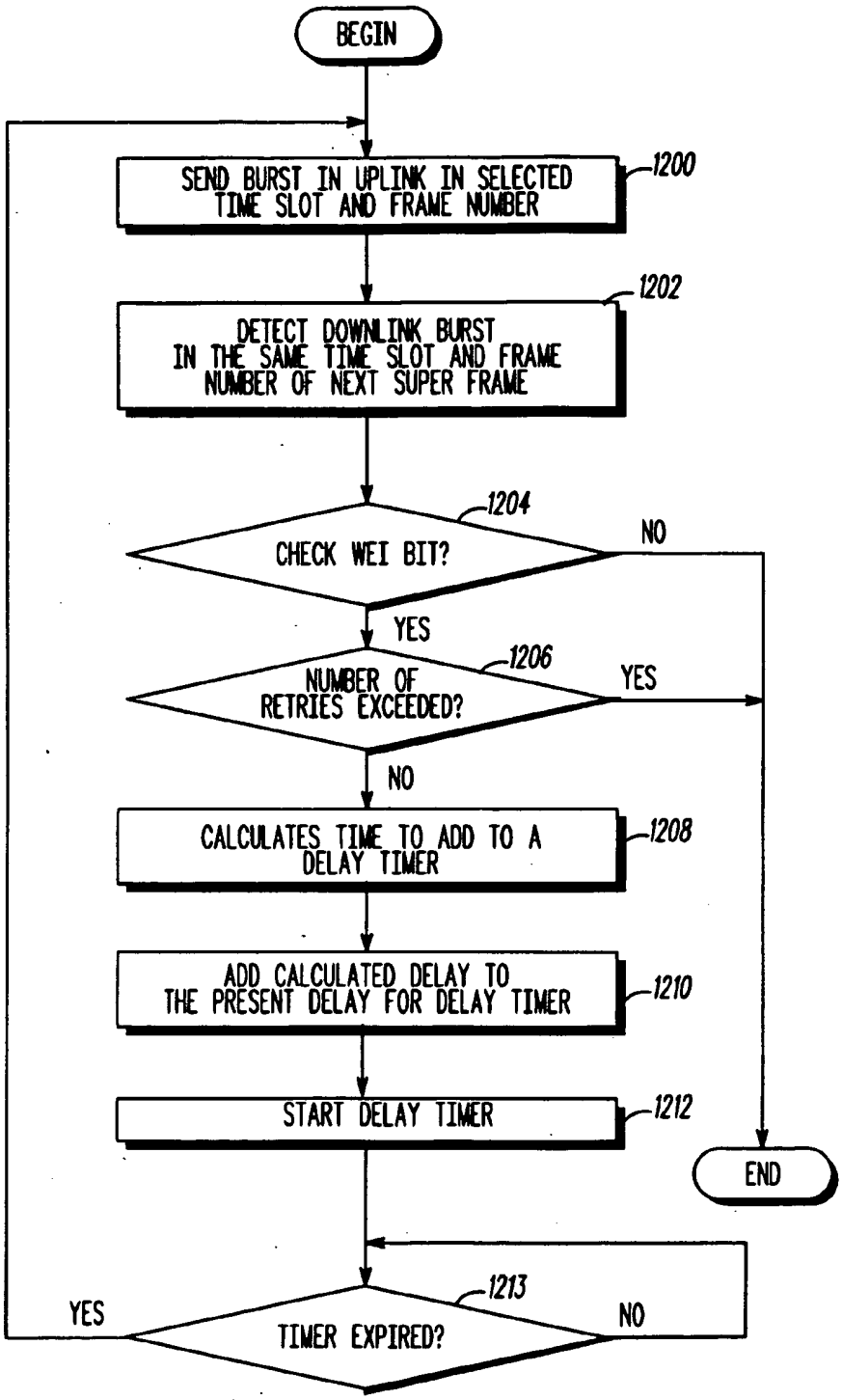

BEGIN
SEND BURST IN UPLINK IN SELECTED TIME SLOT AND FRAME NUMBER
1200
DETECT DOWNLINK BURST IN THE SAME TIME SLOT AND FRAME NUMBER OF NEXT SUPER FRAME
1202
CHECK WEI BIT?
1204
NO
YES
NUMBER OF RETRIES EXCEEDED?
1206
YES
NO
CALCULATES TIME TO ADD TO A DELAY TIMER
1208
ADD CALCULATED DELAY TO THE PRESENT DELAY FOR DELAY TIMER
1210
START DELAY TIMER
1212
END
TIMER EXPIRED?
1213
YES
NO

FIG.12

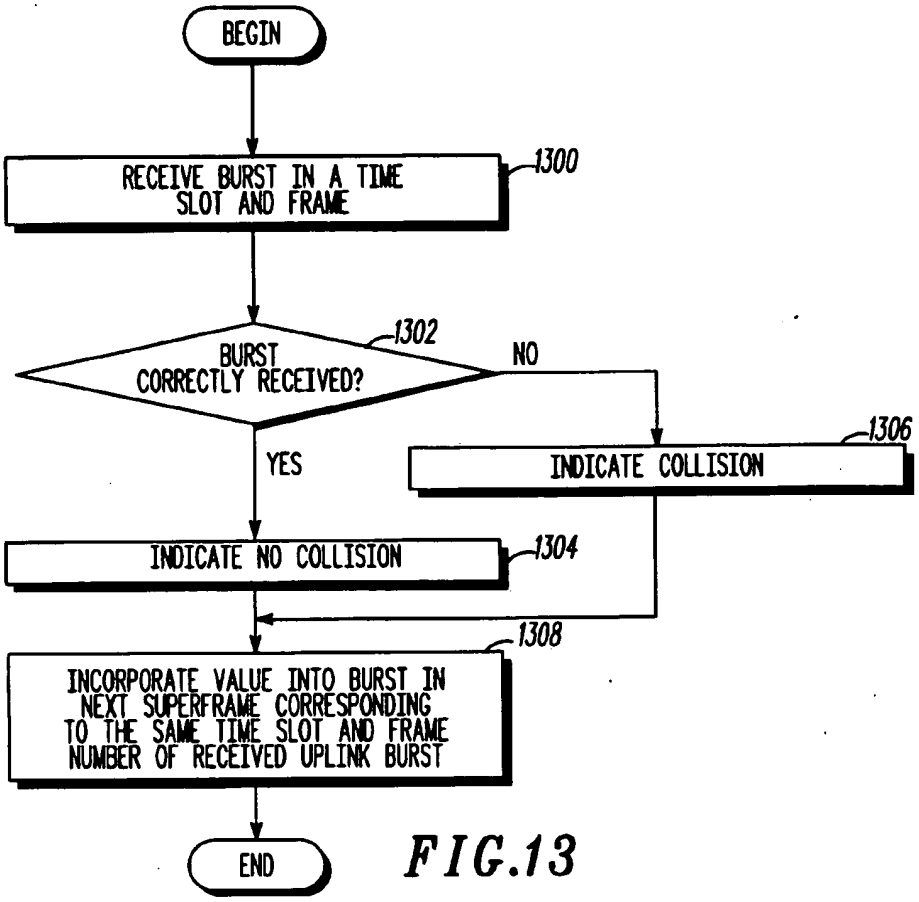

BEGIN
RECEIVE BURST IN A TIME SLOT AND FRAME
1300
BURST CORRECTLY RECEIVED?
1302
NO
YES
INDICATE COLLISION
1306
INDICATE NO COLLISION
1304
INCORPORATE VALUE INTO BURST IN NEXT SUPERFRAME CORRESPONDING TO THE SAME TIME SLOT AND FRAME NUMBER OF RECEIVED UPLINK BURST
1308
END

FIG.13

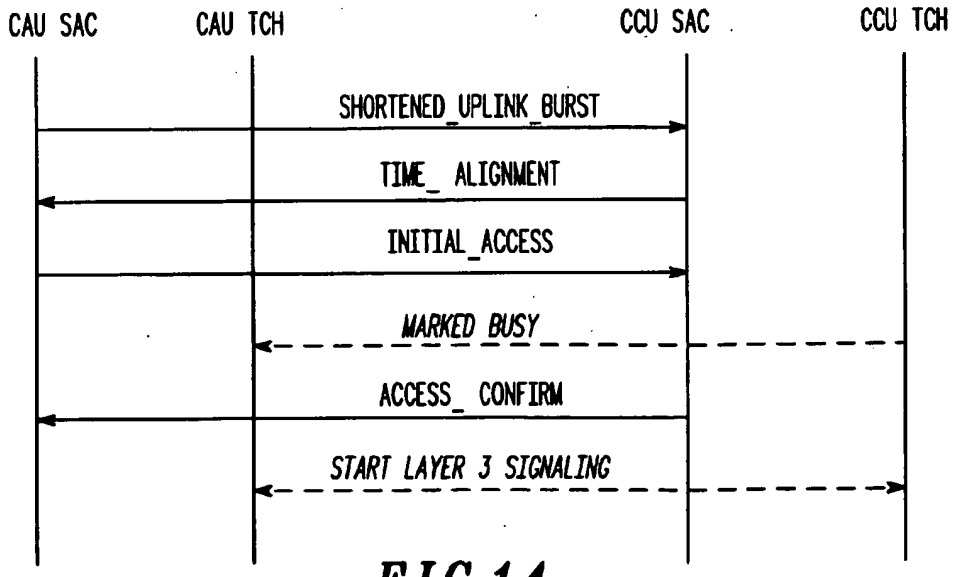

CAU SAC
CAU TCH
CCU SAC
CCU TCH
SHORTENED_UPLINK_BURST
TIME_ ALIGNMENT
INITIAL_ACCESS
MARKED BUSY
ACCESS_ CONFIRM
START LAYER 3 SIGNALING

FIG.14

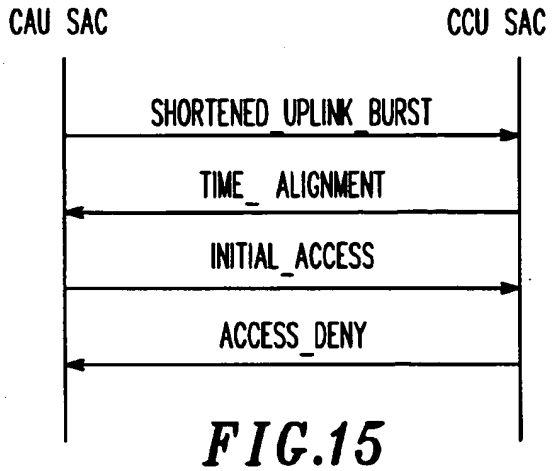

CAU SAC
CCU SAC
SHORTENED_UPLINK_BURST
TIME_ ALIGNMENT
INITIAL_ACCESS
ACCESS_DENY

FIG.15

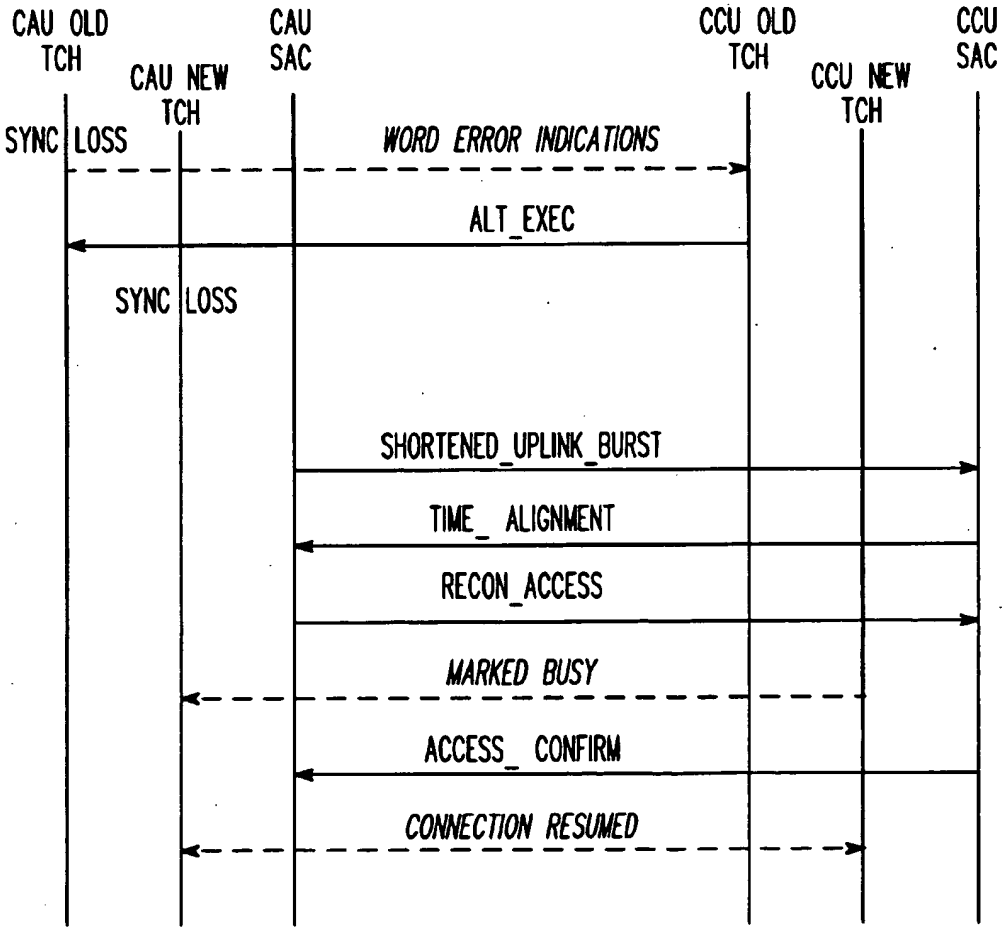

CAU OLD TCH
CAU NEW TCH
CAU SAC
CCU OLD TCH
CCU NEW TCH
CCU SAC
SYNC LOSS
WORD ERROR INDICATIONS
ALT_EXEC
SYNC LOSS
SHORTENED_UPLINK_BURST
TIME_ ALIGNMENT
RECON_ACCESS
MARKED BUSY
ACCESS_ CONFIRM
CONNECTION RESUMED

FIG.16

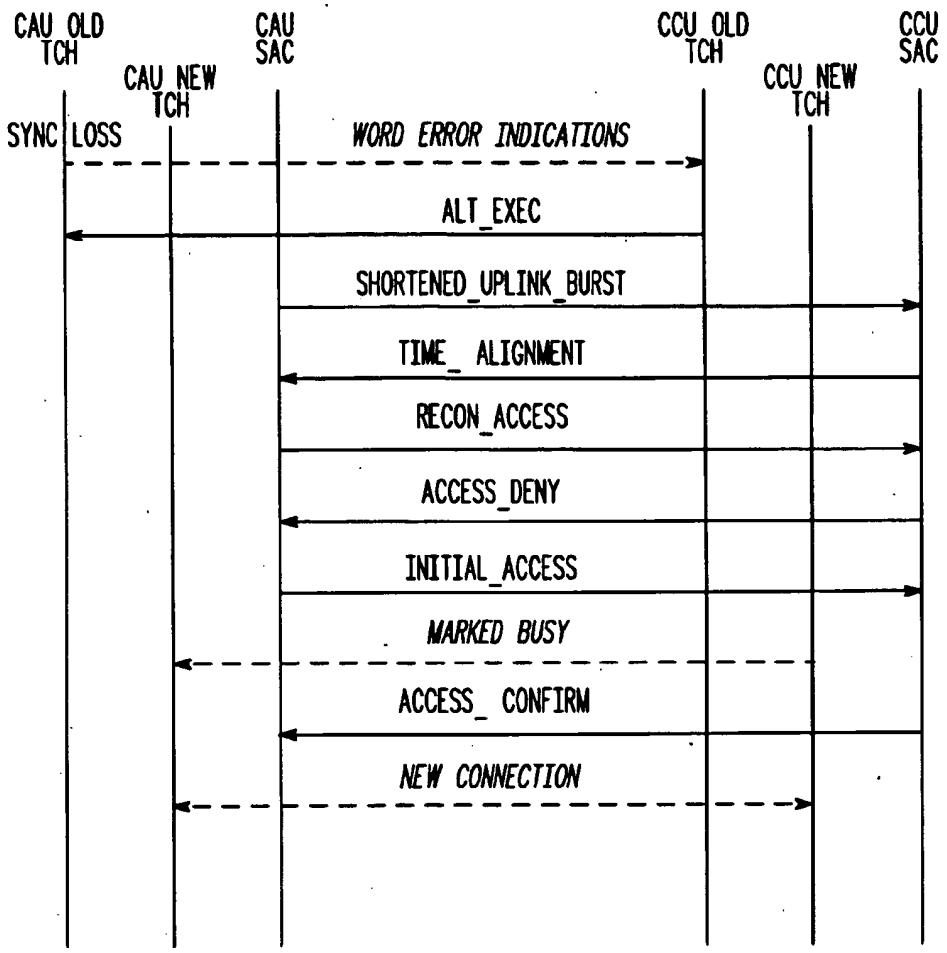

CAU OLD TCH
CAU NEW TCH
CAU SAC
CCU OLD TCH
CCU NEW TCH
CCU SAC
SYNC LOSS
WORD ERROR INDICATIONS
ALT_EXEC
SHORTENED_UPLINK_BURST
TIME_ ALIGNMENT
RECON_ACCESS
ACCESS_DENY
INITIAL_ACCESS
MARKED BUSY
ACCESS_ CONFIRM
NEW CONNECTION

FIG.17

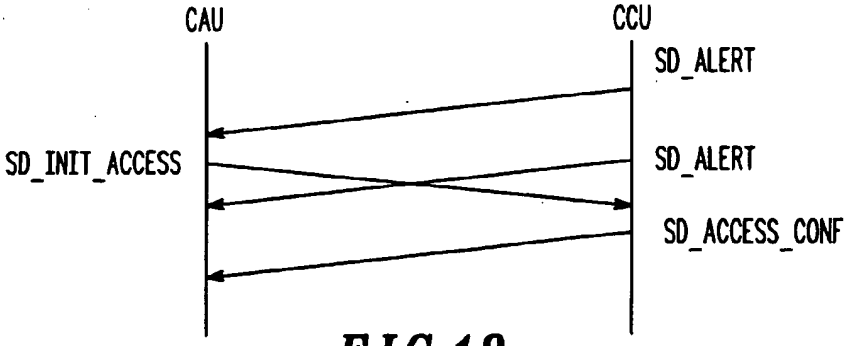

CAU
CCU
SD_ALERT
SD_INIT_ACCESS
SD_ALERT
SD_ACCESS_CONF

FIG.18

METHOD AND APPARATUS FOR MULTIPLE ACCESS OVER RANDOMIZED SLOTS WITH COLLISION DETECTION IN A CABLE TELEPHONY SYSTEM

BACKGROUND

The present invention relates generally to a communications system and in particular, to a method and apparatus for multiple cable access units accessing a cable telephony communications system.

In a cable telephony communications system, frequency division multiplexing (FDM) is employed. FDM allows two or more simultaneous continuous channels to be derived from a transmission medium by assigning separate portions of the available frequency spectrum, separated by some minimal channel spacing within a block of spectrum, to each of the individual channels. FDM provides for a fixed number of physical channels (i.e. separate frequencies) in a cable telephony communications system. To provide more channels to increase the number of users that may operate on a cable telephony communications system, time division multiplexing (TDM) is used. TDM provides time division multiple access (TDMA) in which users share a carrier frequency in the communications system by being assigned and using one at a time, for a limited amount of time, time division multiplex channels (time slots). In effect, each user gets assigned a different time slot on the same frequency. In this way many users can share the same frequency. Data transmissions are sent in time slots in which a communications unit may be assigned a particular time slot only for a limited amount of time.

One of the challenges of a TDMA system is providing to the users access on demand of the TDMA channels. A related challenge is resolving collisions when two or more users try to access or use the same TDMA channel. Consequently, it is desirable to have a system that elegantly provides access on demand of the TDMA channels, and elegantly resolves collisions when multiple users attempt to use the same channel.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself, however, as well as a preferred mode of use, further objectives and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying drawings, wherein:

FIG. **1** is a diagram of a communications system in which the present invention may be implemented;

FIG. **2A** is a block diagram of components in a cable control unit (CCU) according to the present invention;

FIG. **2B** is a block diagram of components in a cable access unit (CAU) according to the present invention;

FIG. **3** is an illustration of spectrum allocations for a communications system according to the present invention;

FIG. **4A** is a diagram of a superframe used according to the present invention;

FIG. 4B is an illustration of a downstream channel and an upstream channel;

FIGS. **5A–5K** are illustrations of different types of information bursts which are employed in providing CAUs access to a communications system according to the present invention;

FIG. **6** is a state diagram of a CAU during system access procedures according to the present invention;

FIG. **7** is a state diagram of a CCU during system access procedures according to the present invention;

FIG. **8** is a depiction of a burst in the TDMA uplink aligned with a slot in the TDM downlink;

FIG. **9** is a flowchart of a process employed by a CCU during an attempt by a CAU to access the communications system according to the present invention;

FIG. **10** is a flowchart of a process employed by a CAU to access the communications system according to the present invention;

FIG. **11** is a diagram of a burst in a downlink control channel according to the present invention;

FIG. **12** is a more detailed flowchart of a process for handling collisions between CAUs attempting to access the communications system according to the present invention;

FIG. **13** is a flowchart of process followed by a CCU for setting a word error indicator (WEI) bit in response to a collisions between CAU bursts sent to the CCU according to the present invention;

FIG. **14** illustrates the signaling between the CAU and the CCU over system access channels (SAC) in which access is confirmed;

FIG. **15** shows signaling between the CAU and the CCU on the SAC in which access is denied;

FIG. **16** is an illustration of signals between a CAU and a CCU resulting in a successful reconnect access request;

FIG. **17** is a diagram of signals between a CAU and a CCU resulting in a failed reconnect access request; and

FIG. **18** is an illustration of signals used for requesting access for an additional call on slow channel.

DETAILED DESCRIPTION OF THE DRAWINGS

The preferred implementation of the present invention allows multiple users of a telephone-over-cable system to access TDMA channels (which carry the calls) on demand. Also, this implementation elegantly and efficiently resolves collisions when two users try to access the same channel. The implementation is somewhat related to two air interface communications protocols, described respectively in Generic Criteria for Version 0.1 Wireless Access Communications Systems (WACS) published by Bellcore, 1993 (TR-INS-001313) and Personal Access Communications System Air Interface Standard J-STD-014 (PACS) published by Technical Ad Hoc Group 3 of the T1/TIA Joint Technical Committee, which documents are incorporated in this description by this reference.

The following description begins with an overview of the cable telephony system. It then describes the electronics in the portion of the system that is at the cable companies' headquarters ("headend"), and then the electronics in the portion of the equipment that is at the subscriber's home or business.

This description then explains how the frequency spectrum that is available on the cable is used by the cable telephony system. Subsequently, this description discusses how the frequencies used by the system are divided into time slots, and how those time slots are structured with respect to the digital messages that they carry. Then, specific message formats are described for some of the particular digital messages sent back and forth in the system to facilitate channel access and collision resolution.

Next, state diagrams are discussed, illustrating the process that the user's equipment goes through, and that the headend equipment goes through, in setting a user up with a TDMA

channel. Subsequently, flow diagrams are shown illustrating the related processes. Finally, examples are shown and discuss of particular signaling scenarios which take place in providing the user access to a channel, and in resolving collisions between users attempting to access the same channel.

I. Overview of the Cable Telephony System

With reference now to the FIGs., and in particular with reference to FIG. 1, a diagram of a communications system is illustrated in which the present invention may be implemented. Communications system **100** is an example of a basic cable system architecture that is a hybrid fiber/coaxial cable (HFC) system using a combination of fiber and coaxial cable to distribute subscriber services to customer premises equipment. Alternatively, communications system **100** may consist entirely of coaxial cable, fiber, or other suitable communications medium. Regardless of the cable infrastructure, a cable branch will serve a distribution area shared by a community of subscribers. In the depicted example, communications system **100** is a cable telephony communications system that provides telephone services along with cable television services on an HFC television infrastructure.

Communications system **100** includes a cable control unit (CCU) **102** or some other base communications unit that is connected to subscribers **104** by a distribution network **106** and a combiner **108**. The CCU is a portion of the equipment at the cable company headend that sends and receives telephone calls to and from the home subscribers. Combiner **108** also has an input for video sources **110**. CCU **102** also includes cable port transceivers (CPXs) **112**, which are connected to combiner **108**. These cable port transceivers generate downstream carrier channels in communications system **100**. "Downstream" or "downlink" as used in this description refers to radio frequency (RF) signals going to the subscriber homes. "Upstream" or "uplink" as used in this description refers to RF signals going from the subscriber to the headend.

Combiner **108** receives modulated RF carriers from video sources **110** and from CPXs **112** in CCU **102** and sums these signals together to be sent over distribution network **106**. CPXs **112** are controlled by a controller **114** which provides all functions necessary to support the data link portion of the system. The "Data link portion" refers to the ability for the system to carry phone calls in the form of digital data, as well as any other communications in the form of digital data. The headend of the communications system typically includes CCU **102**, combiner **108**, and video sources **110**. Digital switch **116** may be in a remote location from the headend or may be located at the headend itself. These components are the headend equipment responsible for providing access and management of services to the cable system **100** servicing multiple subscribers. Controller **119** in CCU **102** is connected to switch **116** through digital carrier facilities, such as T1 or E1, which is in turn connected to a public switching telephone network (PSTN) **118**. Switch **116** may be, for example, a class **5** TELCO switch.

Transmissions from CCU **102** in distribution network **106** are facilitated by downstream fiber trunks **120** and upstream fiber trunks **122**. These fiber trunks are fiber optic cables and are connected to fiber nodes **124**. Fiber nodes **124** perform directional conversion between the optical domain of fiber optical cable and the electrical domain of coaxial cable in distribution network **106**. Each fiber node **124** has a connection to at least one serving area **126**. In the depicted example, serving area **126** comprises coaxial cable and includes trunk amplifiers **128**, which are bidirectional amplifiers in the depicted example. Additionally, bidirectional line extenders **130** are located near taps **132**, which are connected to cable access units (CAUs) **134** located at subscriber **104**. These CAUs are also called "subscriber communications units".

CCU **102** is used to provide telephony (as well as other digital data communications) in communications system **100**. Additionally, CCU **102** controls the cable spectrum, infrastructure resources, and services for all CAUs on a serving area, as well as managing multiple serving areas. CAUs **134** provide telephone and television services at subscriber premises. Typically, a CAU is mounted on the side of the subscriber's home, or on an unintrusive place, such as a basement or attic. The CAU manages the uplink and downlink communications paths and transports cable television channels to the subscriber's television. For example, "A plane old telephone" (POTS) at the subscriber's home plugs into the CAU. The CAU puts the phone signals from the POTS on to the cable system. Additionally, the CAU takes phone calls off the cable system and forwards them to the POTS, as well as taking regular cable TV signals off the cable and passing them along to the subscriber's TV.

II. Overview of Electronics in CCU and CAU

Turning next to FIG. **2A**, a block diagram of components in a CCU control unit is depicted according to the present invention. In CCU **200**, upstream burst receiver **202** receives a TDMA burst from a CAU and down converts the burst to baseband quadrature I and Q signals. A "burst" is a fixed transmission of data in bits bearing information. The burst is $\pi/4$—DQPSK modulated. These baseband I and Q signals are converted to a digital signal by analog to digital (A/D) converters **204** and **206** and processed by upstream digital signal processor (DSP) **208**. In the depicted example, A/D converters **204** and **206** are 8-bit A/D converters. Upstream DSP **208** sends the processed information to microprocessor **210**.

Microprocessor **210** sends messages back to the CAU through downstream DSP **212** and downstream TDM transmitter **214**, which is connected to the communications network on which the CAU is located.

Upstream burst receiver **202**, A/D converters **204** and **206**, upstream DSP **208**, microprocessor **210**, downstream DSP **212**, and downstream transmitter **214** are components found in CPXs **112** in FIG. **1**. The downstream components depicted in FIG. **2A** may be in the same transceiver or a different transceiver (CPX) from the upstream components illustrated. Upstream DSP **208**, microprocessor **210**, and downstream DSP **212** make up a processing unit in FIG. **2A**. Microprocessor **210** is found in controller **114** in FIG. **1**. This microprocessor and the DSPs in CPXs **112** form the processing unit in CCU **102**.

With reference now to FIG. **2B**, a blocked diagram of components in a cable access unit (CAU) is depicted according to the present invention. CAU **250** is connected to a hybrid coaxial cable in distribution network **106** in FIG. **1** by RF interfacing and control **252**. This interface and control unit provides a 75 ohm interface to the hybrid coaxial cable. RF interfacing and control **252** also provides a connection to cable television equipment on the subscriber premises. Additionally, RF interfacing and control **252** includes a control switch to turn on or off signals to premise cable television systems at the subscriber premises. Data received from the CCU at RF interfacing and control **252** are sent to digital receiver (demodulator) **254**. The signals received from the CCU are in a frequency range from about 50 MHz to 750 MHz and converted to a low intermediate frequency (IF) by digital receiver **254**. From this form, digital receiver

254 translates the low frequency IF to a baseband π/4 DPQSK modulated signal. Next the signal is demodulated to obtain bits from the signal. Thereafter, data/clock recovery 256 takes the bits from digital receiver 254 and separates the bits to send to processing unit 258 or pulse code modulated (PCM) coder/decoder (codec) 260. Control information is sent to processing unit 258 while user data is sent to PCM codec 260, which converts the user data into an analog form to be passed along to the subscriber's phone.

Processing unit 258 in the depicted example includes one or more microprocessors or digital signal processors (DSPs) along with random access memory (RAM) and read only memory (ROM). The RAM and ROM contain data and instructions coding for processes performed by the microprocessors or DSPs within processing unit 258. User information is converted by PCM codec 260 to an analog form and sent to subscriber loop interface (SLIC) 262. SLIC 262 provides basic telephony functions, such as indicating whether the phone is ringing or off hook, or whether loop closure has occurred. Additionally, SLIC 262 separates duplex signals into a send signal and a receive signal. SLIC 262 and the functions performed by it are well known to those who are skilled in the art. Ring generator 264 actually provides the voltage used to cause the telephone to ring.

User data from the subscriber premises (such as output from a phone or even output from a standard computer modem) are sent back through SLIC 262 to PCM codec 260, which transforms the data from an analog form to a digital form for processing by transmit data framing 266. Transmit data framing 266 takes raw speech data and puts this data into the frame for transmission to the CCU. For example, transmit data framing 266 includes the necessary synchronization information and calculates the cyclic redundancy code for error checking, which is placed into the slow channel of the frame (as described in more detail below). Transmit data framing 266 is controlled by processing unit 258 and sends signals upstream which are synchronized with the downstream signals. This synchronization in transmit data framing 266 is controlled by data/clock recovery 256. In other words, uplink and downlink transmissions to and from CAU 250 are synchronized. Finally, the data, as a burst, is transmitted by digital transmitter (modulator) 268 to RF interfacing and control 252 and back to the CCU.

III. RF Carrier Spacing, Time Slots in Carriers and Bit Structure of Individual Time Slots

Data carried across distribution network 106 in FIG. 1 may include both voice and non-voice data, such as ISDN digital video, phone data, interactive video, or interactive multimedia services. In the present invention, the transport technology used for the cable telephony exchange service is trunked. In other words, a cable telephony traffic channel is not dedicated to one particular user, but is available to all users on the basis of a request for service. Such an arrangement is called multiple access or subscriber loop concentration.

Typically, once a particular channel is assigned to a subscriber, it is assigned for the duration of a call. When the call is revoked, the channel is made available for a subsequent service request. Consequently, it is possible for a CCU to serve many more subscribers than the channels available in a serving area. Additionally, the whole spectrum can be used over again in each service area that has its own physically isolated cablewire layout.

According to the present invention, the cable telephony communications system divides up the radio frequency (RF) spectrum for use with multiple subscribers such that no individual subscriber has a dedicated frequency range.

With reference to FIG. 3, an illustration of spectrum allocations for communications system 100 is depicted according to the present invention. As mentioned above, the spectrum allocated for service within a single serving area may be used again for a different group of subscribers in every serving area of distribution network 106. In the depicted example, RF spectrum 300 includes uplink spectrum 302 and downlink spectrum 304. In the depicted example, uplink spectrum 302 covers a range from 5 MHz to 42 MHz while downlink spectrum 306 covers a range from 50 MHz to 750 MHz. The spectrums are further subdivided into channels that are each 6 MHz in width. In the depicted example, downlink spectrum 306 includes 120 channels with each channel being 6 MHz in width. Although the depicted example shows an uplink spectrum of 5 to 42 MHz and a downlink spectrum 306 from 50 to 750 MHz with each channel having a width of 6 MHz, other spectrums and channel widths may be used according to the present invention.

Communications system 100 is divided up into areas with separate signal paths in which the RF spectrum allocated for the cable telephony service may be used again for a different group of subscribers in each separate area of the distribution network 106. In the downlink transmission, a large number of conventional television channels (for example 80 channels, each 6 MHz in width) are typically conveyed to cable television subscribers. The uplink spectrum (5–42 Mhz) can be used for any communications returning from the subscriber. A portion of the downlink spectrums, preferably one 6 MHz section as shown in FIG. 3, and an equal or larger portion in the uplink spectrum are dedicated to a plurality of trunked traffic channels serving a large number of subscribers having telephone and/other two way service. Within these dedicated spectrum allocations, a number of RF carriers (exemplified by portions 303) are deployed. These RF carriers are spaced 600 KHz apart. Active carriers are operated in pairs with one in the uplink segment of the allocation associated with each one in the downlink segments. This association provides for frequency division duplex (FDD) operations. Nevertheless, the system is completely flexible in that any of the upstream channels can be matched with any of the downstream channels.

Accordingly, in the preferred embodiment of the invention, a 6 MHz portion (somewhere within 50–750 MHz) contains ten 600 KHz RF carriers 303 used for downstream communications. Similarly, a 6 MHz portion (somewhere within 5–42 MHz) contains ten 600 KHz RF carriers 303 used for upstream communications.

According to this described scheme, each RF carrier is time division multiplexed into eight sequential "frames". Each frame is further broken down into eight sequential "slots". Each of these slots is one time divisioned multiplexed "channel" available for use by a subscriber, upon demand.

FIG. 4A shows the above described scheme diagramatically. The figure represents one RF carrier. The carrier is divided into eight frames 399. Each frame is divided into eight time slots 401, which are each a channel. The whole box 400 shown, i.e. eight frames of eight slots, is sometimes referred to as a superframe.

FIG. 4B shows the scheme in a different way. FIG. 4B shows downstream carrier 402 and upstream carrier 406. More specifically, with reference to carrier 402, two consecutive frames 404 and 405 are shown. These are two of the eight frames 399 in FIG. 4A. Each of the frames is made up of eight consecutive time slots 407. Each of the time slots is available as a communications channel on the cable tele-

phony system. As illustrated by FIG. **4B**, upstream carrier **406** is configured in the same way as downstream carrier **402**.

Each time slot is further partitioned for different types of signaling by by the CCU or CAU. For example, as shown in the figure time slot 1 in frame **404** includes a synchronization channel (SYC) **414**, a control channel (CC) **416**, a slow channel (SC) **418**, a fast channel (FC) channel **420**, and an error control channel (EC) **422**. Sync channel **414** is a synchronization channel used for frame synchronization. CC **416** is used to indicate word errors, signaling, and power control. SC **418** is used for signaling, and FC **420** is used for both user data and signaling. EC **422** is used for error detection. In both the uplink and downlink bursts, SC **418** includes 26 bits, FC **420** includes 160 bits, and EC **422** contains 20 bits. CC **416** contains 2 bits in uplink bursts and 9 bits in downlink bursts. Particular digital messages which use these various portions of the time slot will be discussed in further detail below.

CCU channel **402** is a downlink channel transmitted in a frequency range from 50 MHz to 750 MHz while CAU channel **406** is an uplink channel transmitted in a range from 5 MHz to 42 MHz according to the present invention. A data transmission within these channels is sent as a "burst", which is a fixed length transmission of data, such as a transmission of a group of bits. In the depicted example, a burst is 224 bits per time slot in CAU channel **406** and 240 bits per time slot in CCU channel **402**.

Each time slot in both the uplink and downlink may be used for different types of channels such as a system broadcast channel (SBC), a system access channel (SAC), or a traffic channel (TCH). Each of these different "channels" has a different functionality. The SBC and SAC may both be considered system access channels because of their function. SBCs broadcast system information in the downlink to all CAUs monitoring the SBCs. A downlink SBC carries system wide information, such as alerts used to "page" a CAU and system database information used for controlling and managing CAUs. A SBC is divided into two logical information streams that are time multiplexed onto the SBC. In particular, a system information channel (SIC) and an alerting channel (AC) are time multiplexed onto the SBC. A CAU locates the SBC and listens to the SIC for information of general interest to all devices attached to a CAU. According to the present invention, the SIC identifies general system identifiers and capabilities; security information used for authentication and encipherment; and location of carrier frequencies, SBCs, and SACs.

On the AC, messages are used to notify or "page" a CAU with information, such as an incoming call. These messages include alert identifiers. Each CAU is assigned an alert identifier and monitors the AC to determine whether a message on the AC is directed towards it. Multiple SBCs are used to provide redundancy in communications system.

A CAU uses a SAC to obtain a TCH assignment so that the CAU can place a call, or send other digital data. Additionally, the CAU listens to the AC of the SBC for notification of incoming calls.

The SAC is a physical channel conveying three logical channels, a time alignment channel (TAC), a request access channel (RAC), and a system request channel (SRC). The TAC carries shortened uplinked bursts (SUBs) in the uplink used for time alignment, and the RAC carries access requests in the uplink. The SRC carries responses to uplink messages from the CAU. SACs are employed to perform time alignment and request and/or assign TCHs. As a result, CAU will use a SAC for one of the following purposes: time alignment, initial request for a traffic channel, or reconnect to a traffic channel. Multiple SACs (i.e. multiple slots on the same or different carrier) are used to provide both redundancy and to reduce contention between multiple CAUs requesting access to the communications system. TCHs provide user services on the communications system and may be requested and assigned for varying rates. A TCH is divided into two types of sub channels: a user information channel (UIC) and a message channel (MC). The UIC carries user information, such as voice data or analog modem data. The MC carries signaling information between the CCU and the CAU. TCHs are either busy (in use) or idle (not in use). According to the present invention, the access channels (the SBCs and the SACs) and data channels (the TCHs) may be moved to different frequencies depending on the quality of the carrier transmissions. Changing the frequency of SACs results in the new frequencies being broadcast on the SBCs. Changes in frequencies of a TCH may be performed using an alternate link transfer (ALT) to allow a CAU to maintain a connection in spite of movement of the channel to another frequency. ALTs are known in radio communications but are historically used to maintain a call while a user moves geographically among cells in a cellular system.

V. Format and Content of Specific Messages

With reference to FIGS. **5A–5K**, a number of bursts in the form of requests and responses employed in providing CAUs with access to a communications system are illustrated according to the present invention. Messages between communications units, such as CCUs and CAUs, contain access request numbers (ARNs) to identify to which CAU a particular message is directed. ARNs are unique to each CAU within a serving area. ARNs are employed to uniquely identify messages, such as requests and responses. All bursts or requests from a CAU include an ARN to identify the origination of the burst. Similarly, when responses are sent back to a CAU, the CAU can identify the response as being directed towards the CAU based on the ARN contained within the response from the CCU.

According to the present invention, an ARN, such as ARN **500** in FIG. **5A**, is employed. ARN **500** is a 24 bit ARN and includes an alert value, an alert phase, and a random number. The alert phase indicates the period of time in a superframe that a CAU will monitor the SBC. The use of this alert phase allows a CAU to stay in a standby or sleep mode and activate its receiver only for a brief period of time. The CAU will remain in a sleep mode during most of a superframe and activate its receiver only during its alert phase, allowing for a reduction in power consumption. The alert value is a unique identifier assigned to a CAU and is unique within a particular alert phase. The alert phase and the alert value form an alert identifier that is unique within a serving area. A random number is included in ARN **500** to ensure that a CAU in a serving area will not generate the same ARN twice.

In some instances a 3 bit ARN is employed to identify messages between a CAU and a CCU. In particular, a 3 bit ARN is used when a CAU already has a TCH and sends and receives messages on the SC. A 3 bit ARN can be employed because, in the depicted example, a connection between the CCU and the CAU has been establish, meaning that no other CAUs will be using the channel. As a result, the CCU only needs to be able to distinguish between different requests that the CAU might make. The 3 bit value allows for 8 ARNs to be used by a CAU that can support multiple lines or TCHs.

In accessing a communications system, SAC messages are contained in a single burst to allow each SAC frame to

be equally accessible by any CAU. Typically, messages on a SAC use the full time slot. Thus, misalignment of uplink bursts will cause collisions to occur with other uplink transmissions. Thus, initially, a shortened uplink burst (SUB) is used to determine if any changes in alignment of uplink bursts from the CAU are required. In FIG. **5B**, SUB **502** has a length less than half of a time slot to avoid interference with adjacent time slots according to the present invention. The position of SUB **502** in the time slot is used by the CCU to determined what changes if any are needed to align bursts sent by the CAU within the time slots. In the depicted example, SUB **502** contains three synchronization patterns, such as synchronization pattern **504** (shown in FIG. **5C**), a differential encoder (DE), and an ARN, such as ARN **500** in FIG. **5A**. In FIG. **5B**, the same synchronization pattern is repeated three times within the SUB to increase the chances of the CCU properly receiving and decoding the synchronization pattern. The DE is a two bit value that serves to indicate that a burst is arriving at the CCU and that decoding should begin.

Next, a time alignment response is a response sent by a CCU to a CAU in response to receiving a SUB to indicate if any changes in timing of uplink bursts are needed. With reference to FIG. **5D**, time alignment response **506** contains a time alignment value indicating what change in the timing of transmission of uplink bursts is needed to align uplink bursts within the time slots. In particular this value indicates the change in the offset in time between receiving a downlink burst and transmitting an uplink burst. This response also contains a power control indicator (PCI) and a power adjustment value telling the CAU what transmit power level the CAU should use in transmitting bursts. The PCI tells the CAU whether to increase or decrease the power level of transmissions while the power adjustment value indicates the magnitude of the power level adjustment.

An initial access request, such as initial access request **508** in FIG. **5E**, is sent by the CAU to the CCU on the RAC to initiate a system access request at the CCU. The initial access request **508** identifies the maximum bandwidth rate and minimum bandwidth rate that are desired and/or acceptable in a TCH that assigned to the CAU. According to the present invention these bandwidth rates in communications system **100** may be 8 kilobits per second (kbps), 16 kbps, 32 kbps, or 64 kbps. The initial access request also may include bit s for indicating a priority of the request and a delay value (not shown). The priority of the request may be used to provide different classes of services, such as voice, digital video, or ISDN. The delay time value indicates how long the CAU will wait for a channel assignment before taking some other action, such as sending another initial access request.

Further, a CAU already assigned a TCH using initial access request **508** can send an initial access request, such as initial access request **510** in FIG. **5F**. This request is sent to the CCU on the slow channel. This initial access request on the slow channel is typically a request, from a CAU that can handle multiple connections, for a another TCH for a new connection when the CAU already has an ongoing connection. The access request rate in initial access request **508** is the desired bandwidth for the new TCH.

With reference to FIG. **5G**, a reconnect access request is depicted according to the present invention. Reconnect access request **512** is a request sent by the CAU to the CCU to request another TCH due to a loss of synchronization with a TCH and is sent to the CCU on the RAC in an attempt to reconnect a call. A loss of synchronization can occur when the TCH is assigned and the CAU does not receive notification of the new carrier, or if the physical connection is cut. Reconnect access request **512** includes an uplink carrier ID and a downlink carrier ID specifying the original TCH used by the CAU. The flag bit s indicate whether time slot and bandwidth fields are associated with an active TCH. Multiple time slot and bandwidth fields are used in reconnect access request **512** to allow a CAU that can handle multiple TCHs to request a reconnection of all TCHs at the same time.

In response to requests from the CAU, the CCU sends a number of responses including an access confirm response, which is sent in response to a system access request from a CAU. FIG. **5H** shows an access confirm response **514** that is sent from the CCU to the CAU on the SRC to assign a TCH to the CAU. Access confirm response **514** includes channel assignment information, such as the time slot and bandwidth associated with an assigned TCH. The time slot field tells the CAU which time slot to use while the bandwidth field tells the CAU which frames within a superframe to use for transmitting bursts, such as super frame **400** in FIG. **4A**. For example, time slot **2** and a bandwidth of 64 kbps would tell the CAU to transmit in time slot **2** of every frame of superframe **400**, while time slot **2** and a bandwidth of 32 kbps would tell the CAU to transmit in time slot **2** of every other frame within superframe **400**. Flag bit s indicate whether useful information is found in the associated time slot and bandwidth fields. With an initial access request, only one time slot and bandwidth field will contain information for the CAU because only one TCH is assigned in response to an initial access response. When a request is made to reconnect, the other time slot and bandwidth fields are used when a CAU that can handle multiple TCHs requests a reconnection to more than one TCH.

An access confirm response also may be sent on the slow channel by the CCU to the CAU in response to an initial access request made by the CAU on the slow channel, as illustrated by access confirm response **516** in FIG. **5I**. This type of access confirm response is sent to assign the CAU another traffic channel for a new connection. Access confirm response **516** contains an identification of the bandwidth and time slot of the new TCH assigned to the CAU.

With reference to FIG. **5J**, an access deny response **518** is a message sent by the CCU to the CAU on the SRC to reject a system access request by a CAU. This response is sent to tell the CAU that a TCH will not be assigned to the CAU. On the slow channel, access deny response **520** in FIG. **5K** is denying a CAU another TCH for a new connection. The access deny response includes a cause value, indicating the reason why access was denied. Reasons for denying access may include, for example, inadequate cable resources available, inadequate network resources available, reconnection not possible, or service denied for some unspecified reason.

VI. State Diagrams of CAU and CCU for Allocating a Channel to a CAU

Turning now to FIG. **6**, a CAU state diagram for system access procedures is depicted according to the present invention. State diagram **600** depicts different states of the CAU occurring while accessing communications system **100**. The CAU begins at Null state **A0**. In this state, a SAC is randomly selected based on the number of SACs broadcast in the SIC. The CAU locates a selected SAC on the appropriate downlink carrier and moves to Sync state **A1**, which is the CAU SAC synchronization state. Any access confirm or access deny responses received in Null state **A1** are ignored because the CAU is not listening to the SAC at that time. One of these responses would be received by a CAU if the user hangs up before the system sends an access

confirm or access deny response. When the CAU detects the loop closure, the CAU goes back to monitoring the SBC, which means the CAU will not receive the SAC response from the CCU. As a result, a CCU must be capable of detecting a dead link, which is an assigned traffic channel where the CAU is not transmitting. In all the other states, if the CAU detects a loop closure from the telephone equipment at subscriber premises, the CAU will return to state **A0** and continue monitoring the SBC.

In Sync state **A1**, the CAU continues to try to synchronize to the SAC for a period of time. If the CAU exceeds a selected number of retries, the CAU then transitions back to Null state **A0**, where the CAU may chose to select another SAC for access or indicate an access failure to a higher layer protocol entity. After the CAU has synchronized to the SAC, the CAU waits for a time alignment channel (TAC) uplink indication. Upon detecting a TAC, the CAU sends a shortened uplink burst (SUB) on the TAC and begins a time alignment response timer and transitions to Alignment state **A2**. The time alignment response timer sets a limited amount of time for receiving a time alignment message from the CCU before resending an SUB.

In Alignment state **A2**, the CAU waits for a time alignment message from the CCU. If a collision is detected or the time alignment response timer expires before receiving a time alignment message from the CCU, the CAU adjusts it's transmission power and resends the SUB up to a selected number of times on the SAC. The power adjustment value is a value used to adjust the transmission power of the CAU to a level to achieve an optimal attenuation relative to power level. More detailed information regarding on method of power level control may be found in copending patent application for Method and Apparatus for Adaptive RF Power Control of Cable Access Units, by Timothy M. Burke et al., filed on Oct. 27, 1995, which is incorporated herein. If the number of SUB retries is exceeded, the CAU may select another SAC for access or indicate access failure to a higher layer protocol entity. When the CAU receives a time alignment message from the CCU, the CAU adjusts its transmit offset and waits for a RAC uplink indication. Upon detecting the RAC, the CAU sends an initial access request on the RAC, starts an access response timer, and moves to Access state **A3**. The access response timer is a timer used to limit the amount of time the CAU waits for a response from the CCU in response to the initial access request.

With reference to Access state **A3**, the CAU is awaiting for an access confirm or access deny request from the CCU. If the access response timer expires or the CAU receives an access deny request, the CAU will resend the access request message until a number of retries has been exceeded. If the number of retries is exceeded, the CAU sends a message stating the cause for the access failure and moves back to Null state **A0**. On the other hand, if the CAU receives an access confirm request, the CAU then moves to the assigned traffic channel to perform supervision signaling then moves to traffic channel (TCH) Assigned state **A4**.

In TCH Assigned state **A4**, the CAU waits for a normal release of the channel or a dead link indication. If a normal release is received, the CAU moves back to Null state **A0**. On the other hand, if a dead link indication is detected because of a loss of synchronization or a failed alternate link transfer (ALT), the CAU will perform a reconnect procedure. In particular, the CAU selects a SAC and locates the selected SAC on the appropriate downlink carrier and moves to Sync state **A1**.

With reference now to FIG. **7**, a state diagram of a CCU used for system access procedures is depicted according to the present invention. State diagram **700** depicts the different states of the CCU that occur while handling request for access by a CAU. The CCU begins in Null state BO in which the CCU may have received either an initial access request, a SUB, or a reconnect access message. Reception of an initial access request by the CCU results in the CCU queuing the request with a normal priority and moving to Request state **B1**. When a reconnect access request is received, the CCU queues the request with a high priority and moves to Reconnect state **B2**. Reception of a SUB causes the CCU to calculate time alignment and power adjustment information, format a response, and transition to Dispatch state **B3**.

Turning now to Request state **B1**, the CCU determines whether has the capability of fulfilling the access request. If CCU can fulfill the request, it waits for an available TCH. Upon a TCH being available for assignment, the CCU checks the age of the request. If the request is greater than a selected period of time, the TCH is assigned to another request and the aged request is removed from the queue and the CCU moves back to Null state **B0**. If the request is less than the selected amount of time indicated by the CAU in its initial access request as a delay value, the CCU creates an access confirm response and moves to Dispatch state **B3**.

In Reconnect state **B2**, the CCU determines whether the call can be reconnected. If the call cannot be reconnected, the CCU creates a deny response and moves to Dispatch state **B3**. If the CCU can reconnect the call, the CCU waits for an available traffic channel. Upon a TCH becoming available for assignment, the CCU checks the age of the request. If the request is greater than the amount of time indicated by the CAU in its initial access request as a delay value, the request is "aged", and the CCU assigns the traffic channel to another request and removes the aged request from the queue and transitions back to Null state **B0**. If the request is not aged, and is not greater than the selected amount of time, the CCU creates an access confirm response and moves to Dispatch state **B3**. In Dispatch state **B3**, a response is sent once from the CCU to the CAU. After sending a time alignment or access deny response, the CCU moves back to Null state **B0**. After sending an access confirm response, the CCU begins a verification timer and moves to verify state **B4**. The verification timer indicates the amount of time the CCU will wait for a first burst from a CAU in a time slot that has been assigned to it and the access confirm response.

In Verify state **B4**, the verification timer is active and the CCU is waiting for verification that the CAU is transmitting valid uplink burst on the assigned TCH. If the assignment is verified, the CCU moves back to Null state **B0**. If the verification timer expires, the CCU will initiate procedures to idle the assigned TCH and send an alarm indication and transition to Abandon state **B5**. The CCU in Abandoned state **B5** is idling an assigned TCH. Any uplink bursts received in Abandon state **B5** are ignored. When the TCH has been idled, the CCU moves back to Null state **B0**.

To insure that the communications system using TDMA operates properly, the transmission of bursts from individual CAUs must be aligned within a predefined window, also called a "slot", and cannot overlap adjacent slots, or burst collisions will occur resulting in transmissions errors. As can be seen with reference to FIG. **8**, burst **800** in the TDMA uplink is aligned with slot **802** in the TDM downlink. Time alignment is performed by the CAUs by advancing its burst transmission in time relative to the associated received TDMA downlink signal. The CAUs do not know what propagation delays are occurring through the network. Each CAU has a unique delay because of its physical location on

the distribution cable. It may be necessary to adjust time alignment because of changes in characteristics of the distribution network and environmental conditions such as temperature.

VII. Flow Diagrams Illustrating Allocation of a Channel to a CAU, and Related Processes

The CCU is employed to determine the variable propagation delay by measuring the reception of a shortened burst transmitted from the CAU relative to its processing window. The delay is digitized and conveyed to the CAU in the downlink time slot. A shortened burst from the CAU to the CCU is employed so that any unknown propagation delays do not result in collisions between bursts. Upon receiving the delay compensation number from the CCU, the CAU adjust its burst transmission time for the duration of the call.

With reference now to FIG. **9**, a flowchart of a process employed by a CCU during an attempt by a CAU to access a communications system is depicted according to the present invention. The process beings by indicating a TAC in the downlink (step **900**). Thereafter, a determination is made as to whether a CAU SUB has been received from a CAU (step **902**). If a CAU SUB has been received, a time alignment value and a power adjustment value are determined (step **904**).

More specifically, the CCU measures the relative time difference between the start of the received sample window and the position of the shortened burst. This time difference is expressed in bit times and represents the far-end propagation delay. This value is referred to as the time alignment value. The time difference for the time alignment value is measured from the beginning of the transmission of the downlink bursts to the CCU on the TAC to the beginning of the receipt of the uplink bursts, for the same frame number, time slot, and superframe from the CAU. More information on time alignment can be found on co-pending patent application for Method and Apparatus for Synchronizing Timing of Components of a Telecommunication System by Timothy M. Burke et al. filed on Nov. 29, 1995, which is incorporated herein. The time alignment value is sent to the CAU (step **906**). Thereafter, the RAC is sent in the downlink (step **908**). With reference again to step **902**, if a CAU SUB has not been received, the process then proceeds directly to step **908**.

A determination is then made as to whether a CAU request has been received (step **910**). If a CAU request has not been received, the process then returns to step (**900**). Otherwise, a determination is then made as to whether TCH resources are available (step **912**). If resources are available, then process then sets up a TCH for the CAU (step **914**). Thereafter, an access confirm response is sent to the CAU (step **916**) with the process then returning to step **900**. With reference again to step **912**, if resources are not available, an access deny message is sent to the CAU (step **918**) with the process then returning to step **900**.

Turning now to FIG. **10**, a flowchart of a process employed by a CAU to access a communications system is depicted according to the present invention. The SBC maintains a list of SACs available for system access. This list is broadcast continuously in the SIC. The CAU uses this list to select a SAC and request access to the communications system. The process begins with the CAU monitoring the SBC for a SAC list (step **1000**). At (step **1002**) a CAU event requiring a TCH (for example, a subscriber takes the phone off the hook) occurs. A retry counter is set equal to zero (step **1004**). A SAC is selected from the SAC list (step **1006**). The CAU then retunes and synchronizes to the selected SAC (step **1008**). A determination is then made as to whether synchronization has been achieved with respect to the selected SAC (step **1010**). If synchronization has not occurred, the process then determines whether the number of retries has been exceeded (step **1012**). If the number of retires has not been exceeded, the process increments the retry counter by one (step **1014**) and the process then returns to step (**1006**). Otherwise, the process notifies a higher layer in the communications system of the SAC failure (step **1016**) with the process terminating thereafter. The communications system includes a group of services arranged in layers similar to the Open Systems Interconnection model.

If synchronization has occurred, the retry counter is set equal to zero (step **1018**). Thereafter, SUB is sent on the TAC to the CCU and a time-out timer is started (step **1020**). Thereafter, a determination is made of whether a collision has occurred by checking to see if a word error is present in the word error indicator (WEI) (step **1022**). According to the present invention, the WEI, an expicit data integrity indicator in the downlink SAC is used to detect a collision between two or more CAUs transmitting in the same time slot. For example, when a CAU sends a burst in time slot **3**, frame number **5**, then the WEI in time slot **3**, frame **5**, of the next superframe, will indicate if the burst was received successfully by the CCU. If a collision has occurred, a determination is then made as to whether the number of retries selected for the CAU has been exceeded —(step **1024**). If the number of retries has not been exceeded, the retry counter is incremented by one (step **1026**).

Thereafter, a delay occurs (step **1028**). In the delay (step **1028**), a random amount of time is added to the delay timer. The delay for the timer is set as follows:

$$\text{delay}=(\text{random number MOD } (2^N-1))$$

Also in step **1028**, the delay timer is started and the process does not proceed to (step **1020** to send another SUB until after the delay timer expires). Next, the process returns to step **1022** as described above. With reference again to step **1024**, if the number of retries has been exceeded, the process then proceeds to notify a higher layer of the SAC failure (step **1016**) with the process terminating thereafter. With reference again to step **1022**, if a collision has not occurred the process then waits and determines whether a time-out occurs or a response is received (step **1030**). If a time-out occurs, the process proceeds to step **1024** as previously described. Otherwise, time alignment and transmission power is adjusted as indicated by the received response (step **1032**).

A retry counter is set equal to zero (step **1034**). Thereafter, a request for a TCH is sent on the RAC to the CCU and a time-out timer is started (step **1036**) and a determination is made as to whether a collision has been indicated in the WEI (step **1038**). If a collision has been indicated, as determination is made as to whether the whether the number of retires set for the CAU has been exceeded (step **1040**). If the number of retires has not been exceeded, the retry counter is incremented by one (step **1042**) and the process then performs a delay, as described above in step **1028**, before sending the request again in step **1036**.

With reference again to step **1040**, if the number of retries has been exceeded, the process then proceeds to step **1016** as previously described. If a collision has not occurred a determination is then made as to whether a time-out has occurred or a response is received (step **1044**). If a time-out occurs, the process proceeds to step **1040** as described above. If a response is received, the process then determines whether a TCH has been assigned (step **1046**). If a TCH has not been assigned, the process proceeds to step **1040**.

Otherwise, the process retunes and synchronizes to the TCH (step **1048**) and notifies the higher layer in the communications system of the TCH assignment (step **1050**) with the process terminating thereafter.

A WEI is used to detect a degradation in the quality of transmissions between communications units, such as between a CCU and a CAU on TCHs. The WEI bit is set by the CCU to indicate that an error was detected in a previous burst by a failed cyclic redundancy check (CRC). The WEI is set in the same frame number and time slot of the next superframe in the depicted example. In determining whether the burst was received correctly, the CCU determines whether it is able to detect the synchronization pattern within a burst. If the CAU or CCU is unable to detect the synchronization pattern within a burst, a loss of synchronization has occurred and the WEI will indicate that an error has occurred.

According to the present invention, the WEI also is used to detect collisions between multiple CAUs attempting to access the communications system on access channels such as the SACs. Multiple CAUs attempting to transmit bursts in the same time slot and frame of a SAC result in the CCU being unable to detect the synchronization pattern in the bursts received from the CAUs. This inability to detect the synchronization pattern results from two or more CAUs attempting to transmit bursts in the same time slot and frame of an SAC, rather than from a degradation in transmission quality caused by damage to the cable medium or external noise sources. Additionally, a collision may occur when a CRC fails.

With reference now to FIG. **11**, a diagram of a burst in a downlink control channel from a CCU to a CAU is depicted according to the present invention. Burst **1100** includes a frame number in bits **1** through **3** the burst as being in that particular one of the 8 sequential frames that constitute a superframe. Frames are marked sequentially from 0 ("000") to 7 ("111") in bits **1** through **3**. The value identifies a frame's position within the superframe and is called the frame number. As can be seen, the least significant bit of the frame is transmitted first. Bits **4** through **6** of the control channel mark time slots within a given frame. These time slots are marked sequentially from 0 ("000") to 7 ("111"). The least significant bit is transmitted first. Bit number **7** is reserved for later use according to the present invention. Bit number **8** is the word error indicator and is a "1" when an error has occurred and a "0" when no error has occurred. Bit number **9** in burst **1100** is the fast channel indicator, which indicates whether the fast channel contains signaling information or user information.

Turning now to FIG. **12**, a more detailed flowchart of handling collisions between CAUs is depicted according to the present invention. The process begins by sending a burst in the uplink in a selected time slot and frame number (step **1200**). Thereafter, a downlink burst from the CCU is detected in the same time slot and frame number of the next superframe (step **1202**). The WEI bit is checked to determine whether a collision has occurred or if the burst was correctly received by the CCU (step **1204**). Due to the lag of one superframe, the CAU receives notification of a corrupt burst approximately 20 milliseconds after the burst is sent according to the present invention. If a collision has occurred, the process then determines whether the number of retries has been exceeded (step **1206**). If the number of retries has not been exceeded, the process then randomly calculates an amount of time to add to a delay timer (step **1208**). The delay for the timer is calculated as follows:

$$\text{delay}=(\text{random number MOD } (2^N-1))$$

The calculated delay is then added to the present delay for the delay timer (step **1210**). The delay timer is started (step **1212**) with the process returning to step **1200** to send another burst to the CCU after the delay timer has expired (step **1213**). With reference again to step **1206**, if the number of retries has been exceeded, the process then terminates. Additionally, the process terminates if a collision does not occur in step **1204**.

With reference now to FIG. **13**, a process followed by a CCU for setting a WEI bit in response to a collisions between CAU bursts sent to the CCU is depicted according to the present invention. The process begins by receiving a burst in a given time slot and frame of the uplink at a CPX in the CCU (step **1300**). Thereafter, a determination is made as to whether the burst has been correctly received (step **1302**). In determining whether the burst was received correctly, the CCU determines whether it is able to detect the synchronization pattern within a burst or if a failed CRC is present. If the burst has been correctly received, the process sets the WEI bit to indicate that no collision has occurred (step **1304**). Otherwise, the process sets the bit to indicate a collision has occurred (step **1306**). In either case, the value for the WEI bit is incorporated into the burst in the next superframe corresponding to the same time slot and frame number of the received uplink burst (step **1308**) with the process terminating thereafter.

VIII. Signal Sequences Used in Providing Channel Access and Resolving Channel Contention

FIG. **14** illustrates the signaling between the CAU and the CCU over channels SAC and TCH in which access is confirmed.

A SUB is sent from the CAU to the CCU on the SAC with the CCU sending a time alignment signal back to the CAU. Thereafter, the CAU sends an initial access request on the RAC.

Each access request received by the CCU is queued. The CCU saves the information sent in the uplink transmission from the CAU plus the channel address (carrier and time slot) on which the system access was received. Thereafter, the CCU will transmit either a successful response or a unsuccessful response on the downlink of the SAC on which it received the request.

FIG. **15** shows signaling between the CAU and the CCU on the SAC in which access is denied. The CAU sends a shortened uplink burst to the CCU with the CCU responding with a time alignment response. Thereafter, the CAU sends an initial access request to the CCU as in FIG. **14**, in this case, however, the CCU replies with an access deny response. Upon denial of access, the CAU may either retransmit the request for initial access or report that the maximum number of retry attempts have been exceeded.

A channel refers to the carrier and time slot or slots assigned to a CAU in an access confirm message. Channels are assigned and/or allocated according to the following rules:

1. Time slots on the same carrier as the SBCs and the SACs will be assigned first. The CCU will always try to locate these channels on good carriers. Furthermore, the system will be able to derive problems with SBCs and SACs based on ALT requests from other channels on the same carrier.
2. The available time slots on a carrier will be assigned before moving onto another carrier. The CCU will pack carriers to improve the efficiency and probability of carrier link transfers.
3. When a CCU starts assigning time slots on a new carrier, it will select the carrier with the best quality metrics.

Once a channel has been assigned, the CAU will return to the assigned carrier, and the CAU will use the assigned time slot(s) to perform the call supervision messaging for establishing a call, or connection. Channel assignments will be granted to the top entry of a priority queue.

Each serving area will be associated with a single priority queue for system access requests. Often times errors can occur during transmission of data in which the CAU will try to reconnect to a new carrier from the effected carrier. This transfer of carriers occurs when a CAU experiences loss of synchronization on a downlink carrier. This loss of synchronization is typically reported as a word error indication on the uplink carrier to the CCU. Upon receipt of the word error indication, the CCU performs a downlink transfer from the affected carrier to a new carrier. FIG. **16** is an illustration of signals between a CAU and a CCU resulting in a successful reconnect access request. The CCU will suspend the data link and encipherment (if active) when a command to execute an alternate link transfer (ALT), ALT_EXEC, is sent, whether the CAU sees the ALT_EXEC or not. An ALT is a procedure used to maintain a connection between communications units while a call is in progress in spite of changing frequencies of a channel. When the reconnect request, RECON_ACCESS, is received, the CCU will effectively assign the CAU to same CPX, which will be transmitting the new downlink carrier. Upon assignment of the new channel, the CCU will transmit a busy pattern in the slow channel of the new link, and send an access confirm response to the CAU identifying the new channel. The CAU will retune to the new traffic channel, and resume the data link. The same initial access protocol timers and parameters will apply to the reconnect access procedure.

With reference now to FIG. **17**, a diagram of signals between a CAU and a CCU resulting in a failed reconnect access request is illustrated. This scenario occurs when the CCU is unable to reconnect the CAU. Therefore, when the CAU receives an access deny response in response to it's reconnect access request, RECON_ACCESS, the CAU will send an initial access request to get a new TCH assigned. If the reconnect access request was for multiple connections, then separate initial access requests will need to be sent for each connection. The impact on the customer is that their original call may have been disconnected, in which case, dial tone would be provided to the customer when a new connection is established.

Additionally, in some instances a CAU may use multi-line access to the communications system. A multi-line CAU may use a TCH, of an active call it controls, to request access for an additional call. No contention exists for the TCH already being used by the requesting CAU. As a result, no contention is present for this channel and no SUB is necessary because time alignment already has been performed. Thus, only an initial access, an access confirm and access deny messages need to be sent on the active traffic channel. These are sent on the slow channel portion of the time slot. FIG. **18** depicts a procedure used for requesting access for an additional call on the slow channel. As can be seen with reference to FIG. **18**, the access procedure is initiated by the CCU. If a CAU with multiple active traffic channels loses synchronization, then a signal reconnect procedure will be performed from all of the active traffic channels on the CAU. The traffic channel assignments in the access confirm response will correspond, one-to-one, to the traffic channels specified in the reconnect access request. If an access deny response is received in response to the reconnect access request for multiple traffic channels, the CAU will send individual initial access requests for each of the traffic channels.

The process depicted in FIGS. **6–7** and **9–19** may be implemented by those of ordinary skill in the art within the hardware illustrated in FIGS. **1**, **2** and **3**. The processes of the present invention also may be implemented in a program storage device that is readable by processors within the hardware depicted above, wherein the program storage device encodes executable instructions of the processes of the present invention. The program storage device may take various forms including, for example, but not limited to a hard disk drive, an optical disk, a ROM, an EPROM, or a RAM, which are know to those skilled in the art.

The process stored on a program storage device are dormant until activated by using the program storage device with a processor, such as a microprocessor or a DSP. For example, the processes for providing access to the communications system may be coded as instructions stored on a hard disk drive or an optical disk. Connecting the hard disk drive or the optical disk to the processor in the CCU allows the processor to execute these instructions and control access to the communications system. Additionally, the processes used in handling contention between CAUs for the same time slots may be implemented in a ROM in which the processes become active when the ROM is connected to the CAU.

The present invention provides an improved communications system by providing a separate set of channels used for accessing the communications system. These SACs are separate from the TCHs used for user information, such as a digital voice data. These SACs may move frequencies depending on the quality of transmissions. The SBCs provide a list of the SACs and their locations for access to the communications system. Upon receiving a request for a TCH on a SAC, the CCU assigns a traffic channel to the requesting CAU depending on available resources. This assignment is sent to the CAU on the downlink SAC. Additionally, the present invention provides a method for CAUs to detect and resolve collisions between multiple CAUs attempting to transmit burst on the same time slot. As a result, the methods and apparatus of the presently claimed invention provide for an improved system to access a communications system.

While the invention has been particularly shown and described with reference to a preferred embodiment, it will be understood by those skilled in the art that various changes in form and detail may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. A method for resolving data transmission collisions within a communications system comprising the steps of:

sending a first data transmission from a communications unit to a base communications unit on an uplink channel used for accessing the communications system, wherein the first data transmission includes a synchronization pattern;

monitoring a downlink channel for an explicit data integrity response from the base communications unit, wherein the response is associated with the first data transmission;

determining whether a collision has occurred between the first data transmission and a second data transmission from another communications unit by examining the explicit data integrity response, wherein the explicit data integrity response indicates that a collision has occurred during the first data transmission to the base communication unit when the base communications unit is unable to detect the synchronization pattern; and

automatically retransmitting the first data transmission after a random period of time in response to a determination that a collision has occurred.

2. The method of claim 1, wherein the sending step comprises sending a burst from the communications unit to the base communications unit in a time slot in a frame located in a superframe, the burst including the synchronization pattern.

3. The method of claim 2, wherein the monitoring step comprises monitoring a response from the base communications unit, the response being located in a corresponding time slot and frame within a subsequent superframe.

4. The method of claim 3, wherein the response includes a word error indicator and wherein the determining step comprises determining whether the word error indicator indicates that the base communications unit was unable to detect the synchronization pattern in the burst from the communications unit.

5. The method of claim 4, further comprising selecting the random period of time in response to a determination that an error has occurred from the examination of the response, wherein the automatically retransmitting step occurs in a different time slot.

6. A communication system comprising:

a cable distribution network;

a base communications unit connected to the cable distribution network, the base communications unit generating downlink data transmissions and receiving uplink data transmissions;

a plurality of subscriber communications units connected to the cable distribution network, the plurality of subscriber communications units sending uplink data transmissions to the base communications unit in the cable distribution system to request access to the communications system, wherein uplink data transmissions from a subscriber communications unit within the plurality of subscriber communications unit are associated with downlink transmissions from the base communications unit to the subscriber communications unit and wherein each uplink data transmission and each downlink data transmission includes a synchronization pattern;

the base communications unit monitoring uplink data transmissions from the plurality of subscriber communications units and transmitting and associated downlink data transmission in response to each uplink data transmission, each downlink data transmission including an explicit data integrity indicator indicating whether the base communications unit is able to successfully receive the uplink data transmission; and

a subscriber communications unit within the plurality of subscriber communications units resending an uplink data transmission after a random period of time in response to receiving an associated downlink data transmission from the base communications unit in which the explicit data integrity indicator in the downlink data transmission indicates an inability to successfully receive the uplink data transmission because a collision has occurred between the subscriber communications unit and another subscriber communications unit in the plurality of subscriber communications units.

7. The communications system of claim 6, wherein an uplink data transmission from a subscriber communications unit to the base communications unit is sent in a time slot within a frame, the frame being located within a superframe, and wherein an uplink data transmission from the subscriber communications unit to the base communications unit is associated with a downlink data transmission from the base communications unit to the subscriber communications unit by sending a downlink data transmission in corresponding time slot and frame in a subsequent superframe.

8. The communications system of claim 7, wherein each subscriber communications unit comprises:

sending means for sending a first uplink data transmission from the subscriber communications unit to the base communications unit;

reception means for receiving an associated downlink data transmission from the base communications unit;

determination means for determining whether a collision has occurred between the first uplink data transmission and another uplink data transmission from another communications unit by examining the error indicator in the associated downlink data transmission; and

transmission means for automatically retransmitting the first data transmission after a random period of time in response to a determination that an error has occurred from the examination of the error indicator.

9. A subscriber communications unit comprising:

an interface adapted for connection to a cable distribution network in a communications system; and

a processor connected to the interface in which the processor has a number of modes of operation including:

a first mode of operation in which the processor sends a first uplink data transmission from the subscriber communications unit to a base communications unit, the first uplink data transmission being sent in a time slot in a frame within a superframe;

a second mode of operation in which the processor receives an associated downlink data transmission associated with the first uplink data transmission, wherein the associated downlink data transmission associated with the first uplink data transmission, wherein the associated downlink data transmission is associated with the first uplink data transmission by being received in a corresponding time slot and frame in a subsequent superframe;

a third mode of operation in which the processor determines whether a collision has occurred between the first uplink data transmission from the subscriber communications unit and another uplink data transmission from another communications unit by examining the explicit data integrity indicator in the associated downlink data transmission to the subscriber communications unit; and

a fourth mode of operation in which the processor automatically retransmits the first uplink data transmission after a random period of time in response to a determination that an error has occurred.

10. The subscriber communications unit of claim 9, wherein the first uplink data transmission is a shortened uplink burst including three copies of the synchronization pattern.

11. The subscriber communications unit of claim 9, wherein the first data transmission requests access to the communications system.

12. The subscriber communications unit of claim 9, wherein the first uplink data transmission is sent to the base communications unit in a time slot within a frame, the frame being located within a superframe, and wherein the associated downlink transmission is returned in a corresponding time slot and frame in a subsequent superframe.

13. A storage device readable by a processor in a communications unit and encoding processor executable instructions for handling data collisions, the storage device comprising:

first instruction means for sending a first uplink data transmission from the subscriber communications unit to a base communications unit, wherein the first uplink data transmission requests access to the communications system;

second instruction means for sending a first uplink data transmission from the base communications unit;

third instruction means for determining whether a collision has occurred between the first uplink data transmission from the subscriber communications unit and another uplink data transmission from another communications unit by examining an explicit data integrity error indicator in the associated downlink data transmission; and

fourth instruction means for automatically retransmitting the first data transmission after a random period of time in response to a determination that an explicit data integrity error has occurred, wherein the instruction means are activated when the storage device is connected to a processor.

14. The storage device of claim **13**, wherein the storage device is a read only memory.

15. The storage device of claim **13**, wherein the storage device is a random access memory.

16. A communications unit for use in a cable communications system comprising:

an interface adapted for connection to a distribution network in the cable communications system, the interface providing a connection for sending and receiving data transmissions on the distribution network, wherein data transmissions are transmitted on a plurality of channels, each channel being assigned a portion of a radio frequency spectrum, in which the portion of the radio frequency spectrum is divided by time into a plurality of time slots; and:

a receiver connected to the interface, wherein the receiver receives modulated data signals from the interface and converts the modulated data signals into digital data;

a transmitter connected to the interface, wherein the transmitter converts digital data into modulated data signals for transmission onto the communications system;

a processing unit connected to the transmitter and the receiver;

a subscriber loop interface adapted to be connected to user equipment; and

a pulse code modulated coder/decoder unit connected to the transmitter, the processing unit, and the subscriber loop interface, wherein digital data containing user data is converted into an analog form for use by a user and wherein analog data from a user is converted into a digital form,

wherein the processor sends a first uplink burst to a cable control unit, wherein the first uplink burst is made within a time slot within a frame located within a superframe and the first data transmission includes a synchronization pattern; receives an associated downlink burst from the cable control unit, wherein the associated downlink burst is within a corresponding time slot and frame in a subsequent superframe; determines whether a collision has occurred between the first uplink burst from the processor and another uplink burst from another communications unit by examining an explicit data integrity indicator in the associated downlink burst, wherein the explicit data integrity indicator indicates a collision when the cable control unit is unable to recognize the synchronization pattern; and retransmits the first uplink burst after a random period of time in response to a determination that an collision has occurred.

17. An apparatus for use in a cable communications system comprising:

an interface adapted for connection to a distribution network in the cable communications system, the interface providing a connection for sending and receiving data transmissions on the distribution network, wherein data transmissions are transmitted on a plurality of channels, each channel being assigned a portion of a radio frequency spectrum, in which the portion of the radio frequency spectrum is divided by time into a plurality of time slots; and a processing unit including:

first processing means for sending a first uplink data transmission to a base communications unit, wherein the first data transmission is made within a time slot in a frame located within a superframe and the first uplink data transmission includes a synchronization pattern;

second processing means for receiving an associated downlink data transmission from the base communications unit, wherein the associated downlink transmission is within a corresponding time slot and frame in a subsequent superframe;

third processing means for determining whether a collision has occurred between the first uplink data transmission from the processing unit and another uplink data transmission from another communications unit by examining an explicit data integrity indicator in the associated downlink transmission, wherein the explicit data integrity indicator indicates a collision when the base communications unit is unable to successfully receive the first uplink data transmission; and

fourth processing means for retransmitting the first uplink data transmission by the processing unit after a random period of time in response to a determination that a collision has occurred.

18. The apparatus of claim **17**, wherein the error indicator indicates a collision when the base communications unit is unable to successfully receive the first uplink data transmission because the base communications unit is unable to recognize the synchronization pattern.

19. The apparatus of claim **17**, wherein the error indicator indicates a collision when the base communications unit is unable to successfully receive the first uplink data transmission because a cyclic redundancy check has failed.

20. The apparatus of claim **17**, wherein the processing unit comprises a microprocessor and a random access memory.

21. The apparatus of claim **17**, wherein the first uplink data transmission is a shortened uplink burst.

22. The apparatus of claim **17**, wherein the first data transmission is a shortened uplink burst including three copies of the synchronization pattern.

23. The apparatus of claim **17**, wherein the first uplink data transmission is a request for access to the cable communications system.

24. A communica tions unit for use in a cable communications system comprising:

an interface adapted for connection to a distribution network in the cable communications system, the interface providing a connection for sending and receiving data transmissions on the distribution network, wherein data transmissions are transmitted on a plurality of

channels, each channel being assigned a portion of a radio frequency spectrum, in which the portion of the radio frequency spectrum is divided by time into a plurality of time slots; and

a processing unit having a plurality of modes of operating including:

a first mode of operation in which the processor sends a first uplink data transmission to a base communications unit, wherein the first uplink data transmission is made within a time slot within a frame located within a superframe and the first uplink data transmission includes a synchronization pattern;

a second mode of operation in which the processor receives an associated downlink data transmission from the base communications unit, wherein the associated downlink data transmission is within a corresponding time slot and frame in a subsequent superframe;

a third mode of operation in which the processor determines whether a collision has occurred between the first uplink data transmission of the communications unit and another uplink data transmission from another communications unit by examining an explicit data integrity indicator in the associated downlink transmission, wherein the explicit data integrity indicator indicates a collision when the base communications unit is unable to recognize the synchronization pattern; and

a fourth mode of operation in which a processor retransmits the first data transmission after a random period of time in response to a determination that a collision has occurred.

25. The communications unit of claim **24**, wherein the error indicator indicates a collision when the base communications unit is unable to successfully receive the first uplink data transmission because the base communications unit is unable to recognize the synchronization pattern.

26. The communications unit of claim **24**, wherein the error indicator indicates a collision when the base communications unit is unable to successfully receive the first uplink data transmission because a cyclic redundancy check has failed.

27. The communications unit of claim **24**, wherein the processing unit comprises a microprocessor and a random access memory.

28. The communications unit of claim **27**, wherein the processing unit further includes a read only memory.

29. The communications unit of claim **24**, wherein the first uplink data transmission is a shortened uplink burst.

30. The communications of claim **24**, wherein the first uplink data transmission is a request for access to the cable communications system.

* * * * *

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United States Patent [19]

Lowell

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[45] Date of Patent: Jan. 4, 2000

[54] **INTERNET EVENT TIMER RECORDING FOR VIDEO AND/OR AUDIO**

[75] Inventor: **Richard W. Lowell**, Ramona, Calif.

[73] Assignees: **Sony Corporation**, Tokyo, Japan; **Sony Electronics, Inc.**, Park Ridge, N.J.

[21] Appl. No.: **08/881,052**

[22] Filed: **Jun. 24, 1997**

[51] **Int. Cl.**[7] **G06F 13/38**; G06F 15/17

[52] **U.S. Cl.** **709/218**; 709/231

[58] **Field of Search** 395/200.48; 348/906, 348/10; 386/83; 709/218, 219, 231; 455/6.2, 6.3

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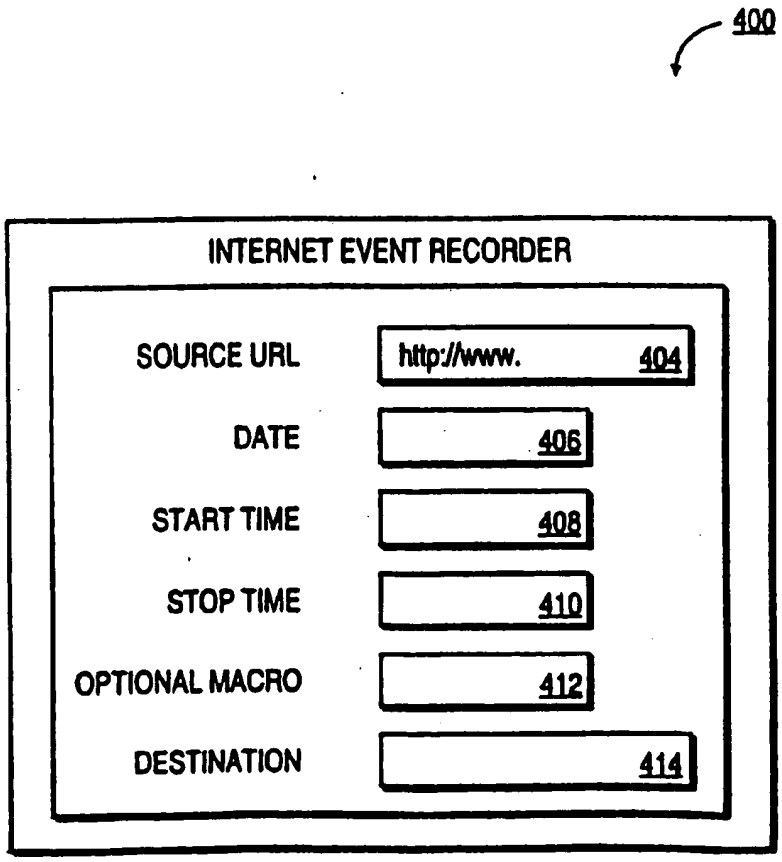
Primary Examiner—Mark H. Rinehart

Attorney, Agent, or Firm—Blakely, Sokoloff, Taylor & Zafman LLP

[57] **ABSTRACT**

A system for automatically recording an event transmitted over a network is provided. A network client is programmed to automatically access a network server at a first specified time, download data from the server to a specified destination device or file, stop the download at a second specified time, and automatically disconnect from the network server. The network client is further programmed to execute additional command sequences required to access the data, and execute diagnostic routines in case of transmission error.

22 Claims, 6 Drawing Sheets



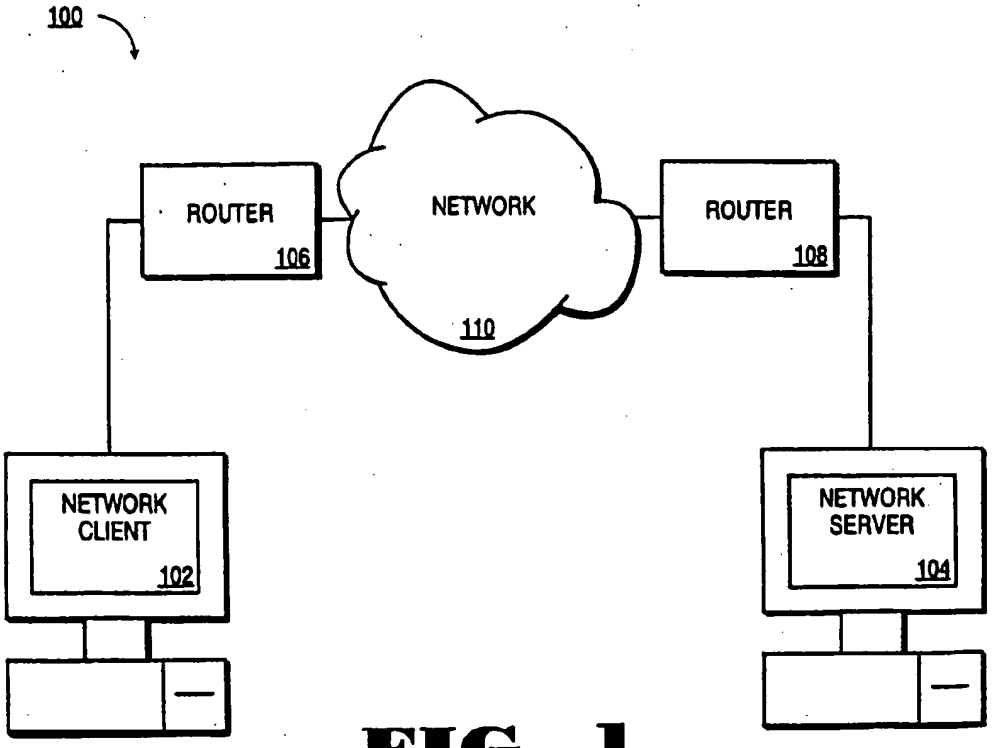


FIG. 1

(Prior Art)

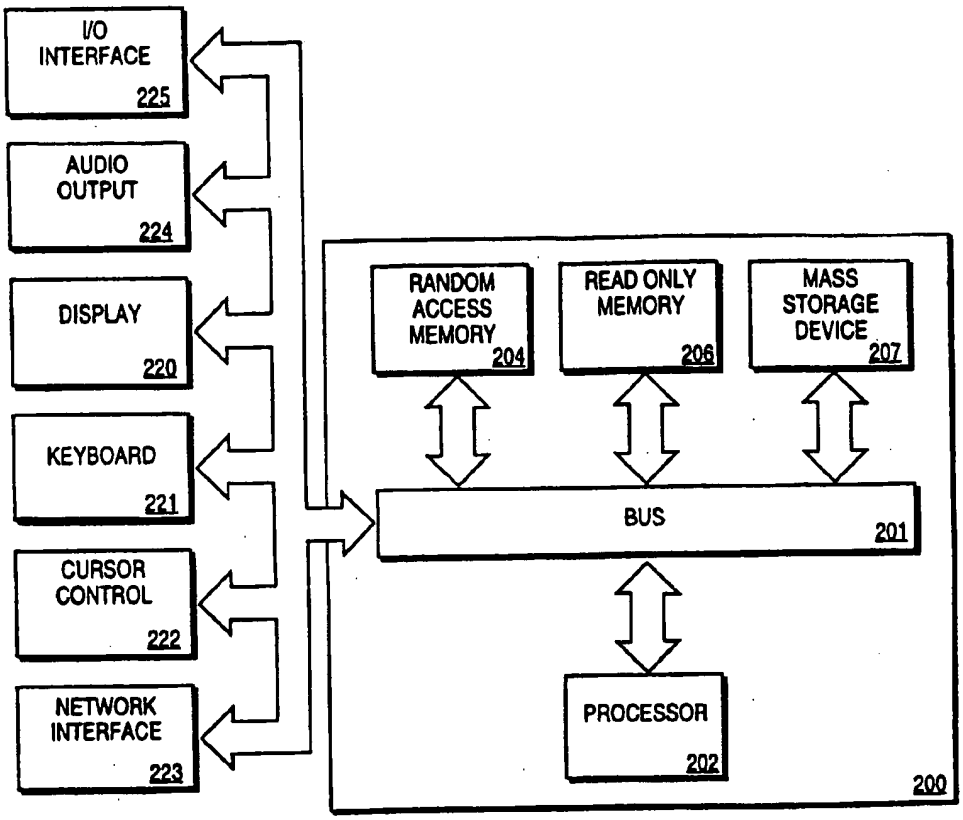


FIG. 2

(Prior Art)

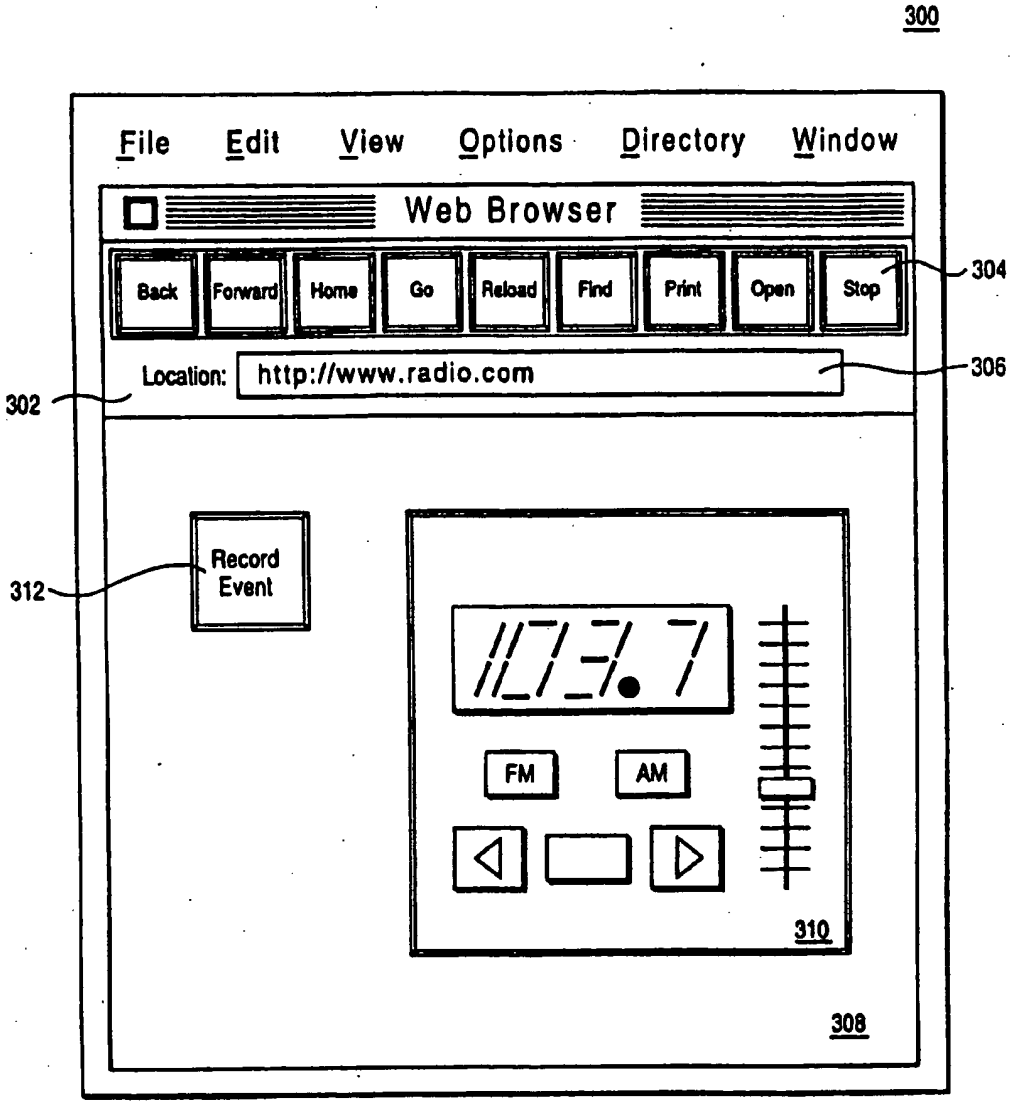

300
File
Edit
View
Options
Directory
Window
Web Browser
Back
Forward
Home
Go
Reload
Find
Print
Open
Stop
304
Location:
http://www.radio.com
306
302
Record Event
312
FM
AM
310
308

FIG. 3

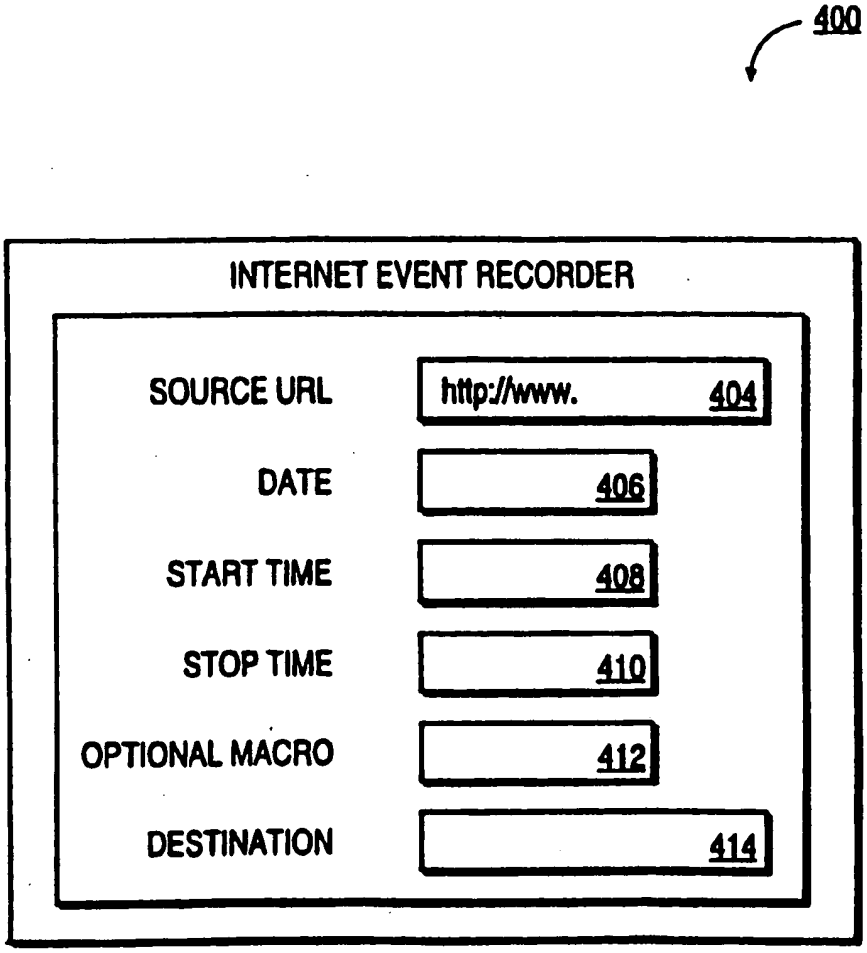

400
INTERNET EVENT RECORDER
SOURCE URL
http://www.
404
DATE
406
START TIME
408
STOP TIME
410
OPTIONAL MACRO
412
DESTINATION
414

FIG. 4

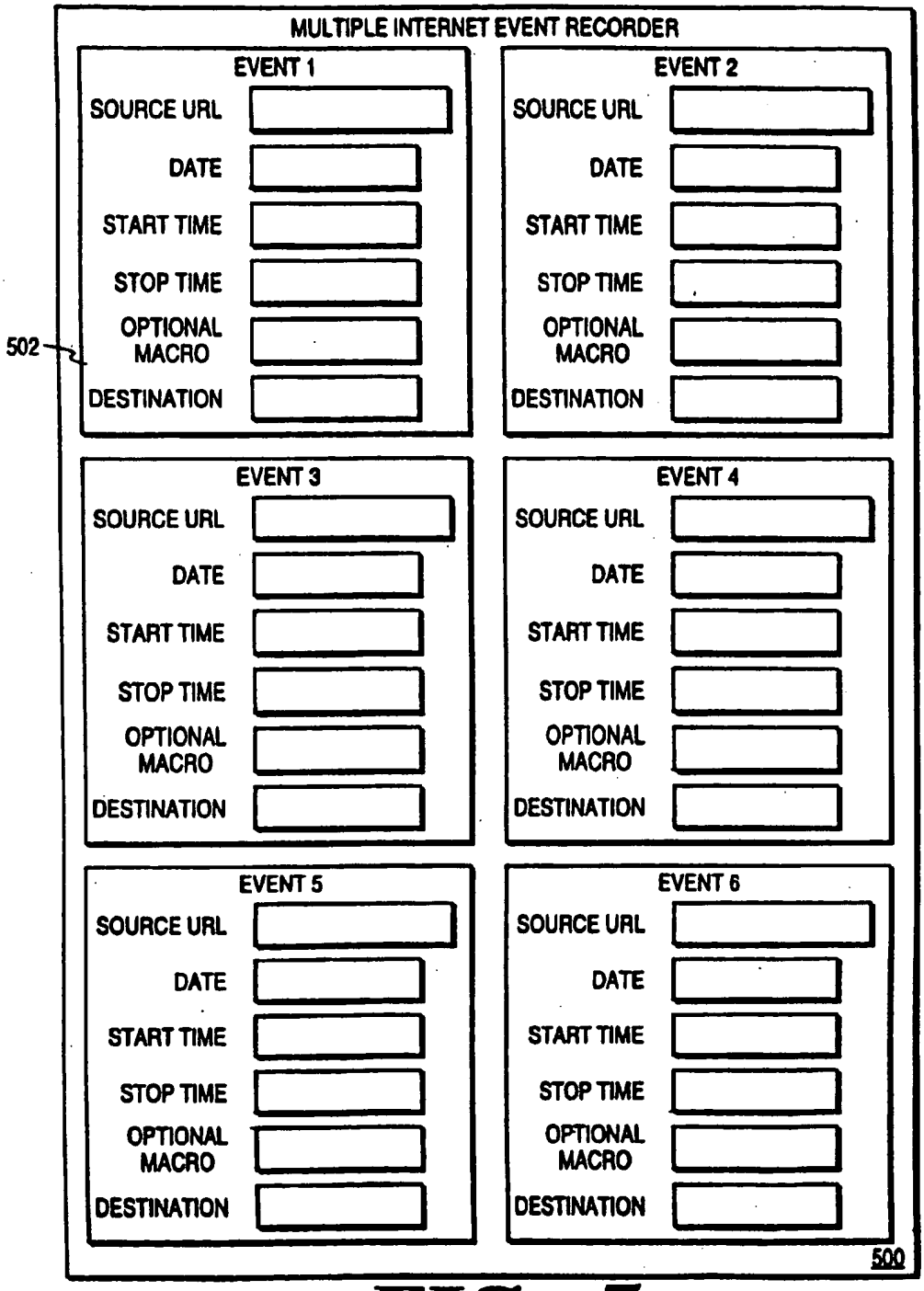

MULTIPLE INTERNET EVENT RECORDER
EVENT 1
SOURCE URL
DATE
START TIME
STOP TIME
OPTIONAL MACRO
DESTINATION
502
EVENT 2
SOURCE URL
DATE
START TIME
STOP TIME
OPTIONAL MACRO
DESTINATION
EVENT 3
SOURCE URL
DATE
START TIME
STOP TIME
OPTIONAL MACRO
DESTINATION
EVENT 4
SOURCE URL
DATE
START TIME
STOP TIME
OPTIONAL MACRO
DESTINATION
EVENT 5
SOURCE URL
DATE
START TIME
STOP TIME
OPTIONAL MACRO
DESTINATION
EVENT 6
SOURCE URL
DATE
START TIME
STOP TIME
OPTIONAL MACRO
DESTINATION
500

FIG. 5

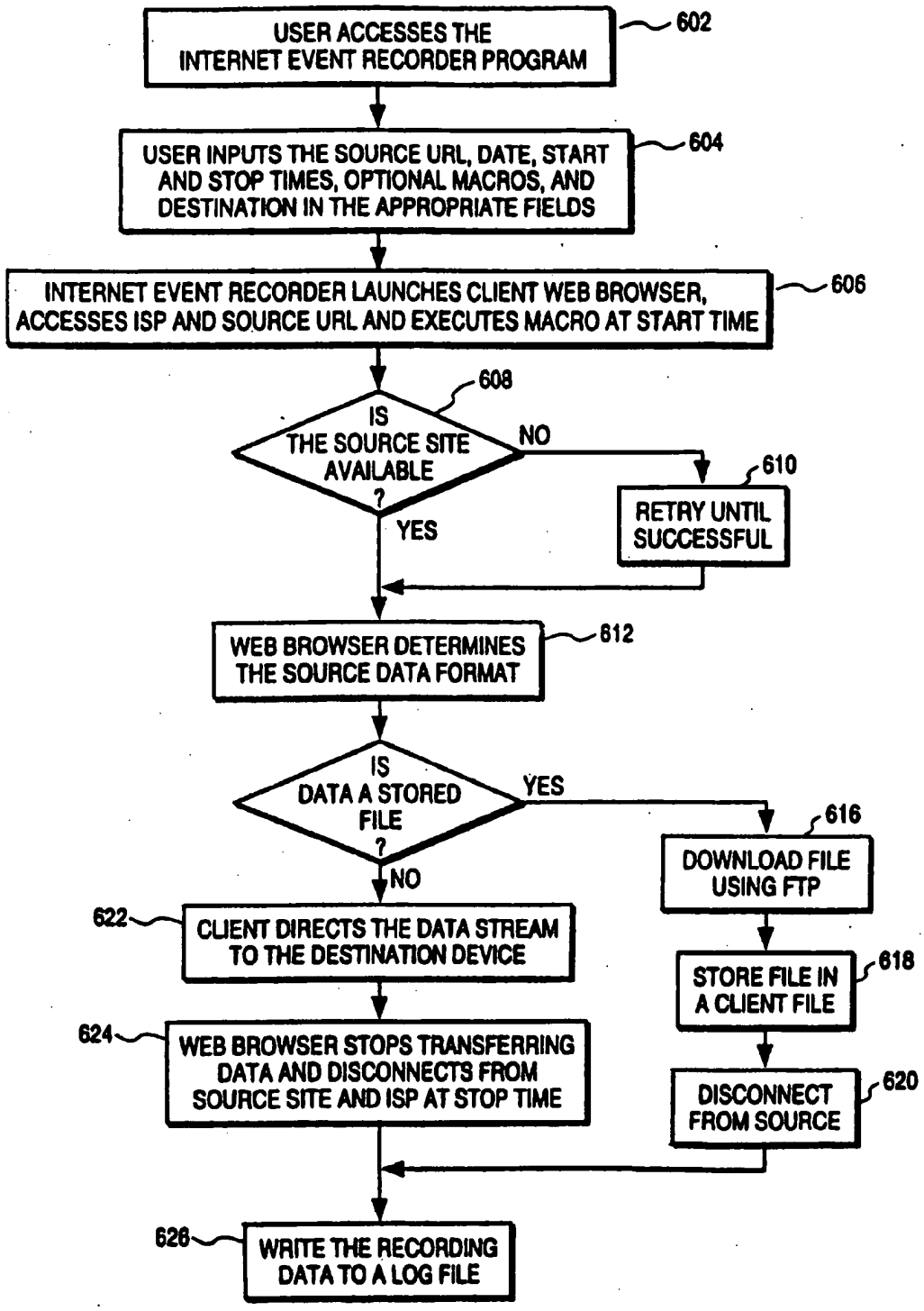

USER ACCESSES THE INTERNET EVENT RECORDER PROGRAM
602
USER INPUTS THE SOURCE URL, DATE, START AND STOP TIMES, OPTIONAL MACROS, AND DESTINATION IN THE APPROPRIATE FIELDS
604
INTERNET EVENT RECORDER LAUNCHES CLIENT WEB BROWSER, ACCESSES ISP AND SOURCE URL AND EXECUTES MACRO AT START TIME
606
608
IS THE SOURCE SITE AVAILABLE ?
NO
610
RETRY UNTIL SUCCESSFUL
YES
WEB BROWSER DETERMINES THE SOURCE DATA FORMAT
612
IS DATA A STORED FILE ?
YES
616
DOWNLOAD FILE USING FTP
NO
622
CLIENT DIRECTS THE DATA STREAM TO THE DESTINATION DEVICE
STORE FILE IN A CLIENT FILE
618
624
WEB BROWSER STOPS TRANSFERRING DATA AND DISCONNECTS FROM SOURCE SITE AND ISP AT STOP TIME
DISCONNECT FROM SOURCE
620
626
WRITE THE RECORDING DATA TO A LOG FILE

FIG. 6

INTERNET EVENT TIMER RECORDING FOR VIDEO AND/OR AUDIO

FIELD OF THE INVENTION

The present invention relates generally to the field of computer networks, and more particularly to recording events transmitted over the Internet.

BACKGROUND OF THE INVENTION

The Internet is increasingly being used to transmit audio, video or audio/visual data. One common example is the incorporation of a music video in a World-Wide Web page as a video clip. A video clip is a sequence of images intended to be displayed in rapid succession to show an animation or moving picture sequence, and may incorporate an audio channel, for the integration of both graphic and audio information. Files containing audio/visual content are usually stored on a network server and made available to network clients upon request. To view such a video clip over the Internet, a user typically boots a web browser and enters the URL (Uniform Resource Locator) for the server which is providing the video file. The user then downloads the file using a network protocol, such as the file transfer protocol (FTP) and then plays the video on the client computer using the appropriate application program.

Although much of the audio/visual data available on the Internet is stored on network servers in the form of files which may be downloaded by a user and played at any time, certain events or programs may only be available at a particular time from a particular server. One such event is an Internet 'webcast', which is an event recorded or videotaped at one location, and then transmitted over the Internet as a live broadcast to be displayed on a web page. Another example is the transmission of radio or television broadcasts over the Internet. Such events are often not stored on a server as perpetual files, but instead are simply transmitted over the network as they occur. Thus, a user has only a limited opportunity to view or listen to these events.

Present Internet access devices and web browser programs do not provide a means for automatically recording a simulcast or one-time program or event. In order to access such events, it is necessary for the user to log-in to the source web site and view or listen to the event at the specified time. There are times, of course, when it may be inconvenient or impossible for the user to manually access the event, in which case the user loses the opportunity to view or listen to the event.

It is thus desirable to provide a system for recording an event which is available over a network for only a limited time, thus allowing a replay of the event at a later time. It is further desirable to provide a mechanism for programming the automatic recording of the event, thus eliminating the need for a user to manually access the event and initiate the recording process.

SUMMARY OF THE INVENTION

The present invention discloses a method and apparatus for automatically accessing and recording events transmitted over a network. In a method of the invention, a network interface device is programmed to access a network server, initiate the downloading of data from the network server to a storage device at a programmed start time, stop the transfer of data at a programmed stop time, and disconnect from the network server. The data to be recorded may be transmitted as either a computer readable file or as a digital bitstream,

depending on the format of the data on the server. On the client, the data may be transferred to a computer storage device, such as a hard disk, or it may be transferred to an analog recording device, such as a video cassette recorder.

In an embodiment of the present invention, an event recorder program is executed on the client computer and provides a dialog box for the entry of certain event recording parameters. These event recording parameters include the network address for the event server, the start and stop times of the recording session, and the descriptor for the target file or recording device which stores or records the downloaded data. The event recording parameters may also include a command sequence which may be required to access a recordable event on the server, and diagnostic routines for failure recovery. The event recording program performs the recording process by automatically logging in to the source server at the programmed start time, initiating the data transfer to the destination location and disconnecting from the source server at the programmed stop time.

Other features of the present invention will be apparent from the companying drawings and from the detailed description which follows.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is illustrated by way of example and not limitation in the figures of the accompanying drawings, in which like references indicate similar elements, and in which:

FIG. **1** illustrates a network including client/server computers transmitting and receiving data.

FIG. **2** is a block diagram of a client computer system which may be used to implement an embodiment of the present invention.

FIG. **3** illustrates a World-Wide Web page which provides access to programmed events transmitted over the Internet.

FIG. **4** illustrates a dialog box for programming event parameters for a single event, according to one embodiment of the present invention.

FIG. **5** illustrates a dialog box for programming event parameters for multiple events, according to one embodiment of the present invention.

FIG. **6** is a flowchart illustrating the process of programming the recording of an Internet event according to one embodiment of the present invention.

DETAILED DESCRIPTION

A system for recording an audio/visual event transmitted over the Internet and accessed through a web browser is described. In the following description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the present invention. It will be evident, however, to one skilled in the art that the present invention may be practiced without these specific details. In other instances, well-known structures and devices are shown in block diagram form to facilitate explanation.

Hardware Overview

According to the present invention, client computer systems in a network request and receive files or data streams consisting of audio, visual, or audio/visual data. According to one embodiment, the steps of accessing, downloading, and manipulating the data, as well as other aspects of the present invention are implemented by a central processing unit (CPU) in a client computer executing sequences of instructions stored in a memory. The memory may be a

random access memory (RAM), read-only memory (ROM), a persistent store, such as a mass storage device, or any combination of these devices. Execution of the sequences of instructions causes the CPU to perform steps according to the present invention.

The instructions may be loaded into the memory of the client computer from a storage device or from one or more other computer systems over a network connection. For example, a server computer may transmit a sequence of instructions to the client computer in response to a message transmitted to the server over a network by the client. As the client receives the instructions over the network connection, the client stores the instructions in memory. The client may store the instructions for later execution or execute the instructions as they arrive over the network connection. In some cases, the downloaded instructions may be directly supported by the CPU. Consequently, execution of the instructions may be performed directly by the CPU. In other cases, the instructions may not be directly executable by the CPU. Under these circumstances, the instructions may be executed by causing the CPU to execute an interpreter that interprets the instructions, or by causing the CPU to execute instructions which convert the received instructions to instructions which can be directly executed by the CPU. In other embodiments, hardwired circuitry may be used in place of, or in combination with, software instructions to implement the present invention. Thus, the present invention is not limited to any specific combination of hardware circuitry and software, nor to any particular source for the instructions executed by the client computer.

FIG. **1** illustrates a network **100** in which audio/visual data is transmitted between networked computers. Client computer **102** is coupled to a server computer **104** through network **110**. The network interface between client **102** and server **104** may also include one or more routers, such as routers **106** and **108**, which serve to buffer and route the data transmitted between client **102** and server **104**. Network **110** may be the Internet, a Wide Area Network (WAN), a Local Area Network (LAN), or any combination thereof. Network server **104** contains application programs and/or data which are accessible over the network by other network stations, such as network client **102**. In one embodiment of the present invention, network server **104** is a World-Wide Web (WWW) server which stores data in the form of 'web pages' and transmits these pages as Hypertext Markup Language (HTML) files over the Internet network **110** to network client **102**. To access these files, network client **102** runs a 'web browser', which is simply an application program for accessing and providing links to web pages available on various Internet sites. In a typical Internet client-server environment, the client computer accesses the Internet through a single point of contact, commonly referred to as an Internet Service Provider (ISP) or on-line service provider.

FIG. **2** illustrates a block diagram of a representative client computer such as network client **102** illustrated in network **100** of FIG. **1**. The computer system **200** includes a processor **202** coupled through a bus **201** to a random access memory (RAM) **204**, a read only memory (ROM) **206**, and a mass storage device **207**. Mass storage device **207** could be a disk or tape drive for storing data and instructions. A display device **220** for providing visual output is also coupled to processor **202** through bus **201**. Keyboard **221** is coupled to bus **201** for communicating information and command selections to processor **202**. Another type of user input device is cursor control unit **222**, which may be a device such as a mouse or trackball, for communicating direction commands which control cursor movement on display **220**. Also coupled to processor **202** through bus **201** is an audio output port **224** for connection to speakers which output the audio content produced by computer **200**. Further coupled to processor **202** through bus **201** is an input/output (I/O) interface **225** which can be used to control and transfer data to electronic devices connected to computer **200**, such as other computers, tape recorders, and the like.

Network interface device **223** is coupled to bus **201** and provides a physical and logical connection between computer system **200** and the network medium. Depending on the network environment in which computer **200** is used, this connection is typically to a network router, but can also be directly to another computer. Note that the architecture of FIG. **2** is provided only for purposes of illustration, and that a client computer used in conjunction with the present invention is not limited to this specific architecture.

In one embodiment of the present invention, network client **102** is a personal computer which interfaces to network **110** through a modem, or similar network interface device. In an alternative embodiment the network client **102** represented by computer system **200** may be a dedicated Internet access product, such as a Network Computer (NC), or a dedicated WorldWide Web client such as the WebTV™ system developed by WebTV Networks, Inc.

Internet Events

Popular application programs, such as web browsers, which display audio/visual sequences transmitted over the Internet allow a user to easily capture and view or listen to the transmitted data. Present programs, however, do not provide mechanisms which allow unattended recording of the data on a data storage device.

The present invention includes a method for automatically accessing and recording audio/visual events which are available from a network server. The present invention may be used with data which represents only audio data (e.g., a sound recording), or only video data (e.g., a silent movie), or combined audio/visual data (e.g., a movie with sound). The present invention may also be used with any network, including the Internet, or the World-Wide Web portion of the Internet, or any local or wide area network (LAN/WAN). For purposes of explanation, however, the following description will focus on automatic recording of audio/visual events from the World-Wide Web and it will be appreciated that the invention is not limited to this use.

Many audio/visual sequences such as music videos or excerpts from movies or television shows are available on Internet sites by servers which maintain World-Wide Web pages. A server provides access to video clips stored in its memory through a web server program, and a client downloads and displays information from the network using a web browser program. Many web browsers also provide 'plug-ins' which are software components that extend a web browser's capabilities. Popular plug-ins include programs which facilitate the presentation of sophisticated data such as multimedia events. For example, the RealAudio plug-in for the popular Netscape Navigator web browser provides live and on-demand real-time audio, which allows web servers to deliver audio content from their sites, and web clients to playback the audio content on their sites. Another similar plug-in is StreamWorks, which provides playback capability of both audio and video on a web client. Some playback programs allow a client to directly access bit-streamed data as the data stream is received over the network, thus eliminating the need for a user to first download and then play a data file.

FIG. **3** illustrates a sample web page for a server which provides broadcast audio content. Screen display **300** illus-

trates the display of the web page as it appears when displayed by a web browser on a client computer, such as network client **102** in FIG. 1. Screen display **300** includes a web browser window **302** which contains several different fields. These fields include an option button field **304**, a Uniform Resource Locator (URL) field **306**, and web page **308**. Web page **308** contains text and/or graphic information transmitted by the web site server specified in URL field **306**.

Web page **308** may include a display window **310** for the display of a program or event. In the sample web page of FIG. **3**, display window **310** includes a simulated radio control panel tuned to an on-line radio station. This control panel indicates that a user can listen to a live radio broadcast provided by the network server and transmitted to the network client over the Internet. Additionally, the live radio broadcast may be recorded immediately over a set duration or set up for future recording and subsequent playback. In order to adequately play back the radio broadcast, the client computer may need to execute the appropriate audio software (which may be a web browser plug-in).

Although FIG. **3** illustrates a server web page for an on-line radio application, it should be noted that FIG. **3** is meant to exemplify a web page which provides access to any type of multimedia content, such as a movie, video clip, or live transmitted event (a 'webcast'). In this case, the event might contain both audio and video data, and the web browser would need to execute the appropriate viewing software to display the program or event indicated in window **310**.

In the above discussion, it is assumed that the event to be viewed or listened to is available simply at the location specified in URL field **306**. That is, the event is stored at a location that is directly accessible to a client computer. In some cases, however, the event is not directly accessible at a particular web address. In these cases, the web address may only specify the server location, and further commands or options must be executed in order to play the video clip or audio program. For example, the program or event displayed in window **310** may be accessed within web page **308** by specifying a sub-address within URL field **306** or by selecting an additional hypertext link or option button displayed in web page **308**. Similarly, some server sites might require that a user have an account or other payment means to access the site. In this case, the user might be required to enter a user ID or account password to access the site.

Recording an Internet Event

The network environment illustrated by FIG. **1** will be used to describe the method of the present invention. In network **100**, server **104** stores an audio/visual sequence which will hereinafter be referred to as an Internet "event". Upon request by client **102**, server **104** transmits the Internet event over network medium **110** for display on client **102**. A typical event, such as a video clip, contains audio data representing a music or voice track, and a series of digital graphic images which form a video sequence. The web server **104** may transmit either or both components of the event in the form of self-contained executable data files or as digital bitstreams to the client. Web server **104** may also provide broadcast content over network **110**. For example, server **104** may provide access to an Internet radio web site such as that illustrated in FIG. **3**.

In one embodiment of the present invention, an automatic event recorder (hereinafter referred to as the "Internet event recorder") is available as a program which is executable by the computer operating system of the client computer, or the communication software of the network interface device which connects the client computer to the Internet. Upon execution, the Internet event recorder accesses and launches a web browser on the client to access the source site. If more than one web browser program is available on the client computer, the Internet event recorder may be programmed to select a specific web browser to be launched. According to one embodiment of the present invention, the Internet event recorder is programmed through a dialog box which is displayed on a display device connected to client computer **102**. Depending on how it is implemented, the dialog box can be accessed by entering the program name on a command line, selecting the program name or command from a pull-down menu, or by selecting an onscreen option button.

In an alternative embodiment of the present invention, the Internet event recorder may be available as a plug-in program for a web browser running on a client computer, or as an extension to an existing web browser plug-in. In this case, the Internet event recorder may be invoked by selecting an option button on the web browser, if one is available.

FIG. **4** illustrates a representative Internet event recorder dialog box. Internet event recorder dialog box **400** includes several fields which allow the input of data by the user through an input device. The first field **404** is the source URL field. In this field the user types the URL or Internet address for the web site of the server which is providing the data to be recorded. Field **406** is the date field in which the user types the date on which the event is to be recorded. The date may be specified as a single day if a single event is to be recorded; or the date may be specified as a range of dates (e.g., "1/1 to 1/5") or selected days (e.g., "every day" or "every Saturday") if a recurring event is to be recorded. In field **408**, the user inputs the start time at which the recorder is to start recording, and in field **410** the user enters the stop time which is the time at which the recording is to be stopped. Alternatively, field **410** may be programmed with the duration of the recording session starting from the start time (e.g., +2 hours). The time parameters can be entered in standard 12-hour clock format with a.m. or p.m. indicators, or alternatively they can be entered in 24-hour format. Additional parameters which may be programmed into the time fields include an adjustment for time zone variations and automatic correction for daylight savings time (e.g., if the client and the server computers are located in different time zones).

Field **412** provides an entry field for an optional macro or program routine. A macro or command string may be required if access to the actual audio or video data to be recorded is not directly accessible from a URL specified in the source URL field, **404**. For example, downloading or accessing an audio or video data stream might require the input of certain control keys, the entry of a network sub-address, or the entry of a user ID or access code (as in the case of a service which requires a payment account). Once the user has determined a particular key sequence or macro which must be performed to access data within a particular source or server web site, he may enter this sequence in macro field **412**. Upon access to the source URL, the web browser will automatically perform the macro or command key sequence which has been entered into optional macro field **412**. Thus, the event file or data stream can be accessed automatically in the manner which would be required if the user were performing that function manually.

Field **414** provides a field in which the user enters the destination for the data stream or data file. Typically the destination is the name of a file which has been created on a hard disk for storage of the data stream or file. Alternatively, however, destination field **414** can store a

descriptor specifying an external device, such as a tape recorder, which is controlled by the client computer. In one embodiment of the present invention, the Internet event recorder may be configured to record the data stream or file to a default device, such as a hard disk. In this case, a destination field is not required since the recorded event will automatically write the data to the default device.

It should be noted that additional fields, other than those explicitly shown in FIG. **4** may be provided to extend the functionality of the Internet event recorder. For example, a retry field may be provided to specify the number of times to retry a source URL connection if the source server is busy, or an ISP if the ISP line is busy or a line drop occurs. Such a retry field may also be used to store an alternate source server URL or an alternate ISP telephone number, if such alternates are available. Similarly, a failure field may be included to provide an error message or execution of a diagnostic routine in the case of a failed or interrupted network connection. Another possible additional field, which may be included if the Internet event recorder is implemented as a stand-alone program, is a field which specifies the web browser to be launched to provide access to the source site. Such a field would allow the user to select a particular web browser if more than one web browser is available on the client computer.

In one embodiment of the present invention, more than one Internet event may be recorded by the Internet event recorder. In this case multiple entry windows may be provided in the record window of the Internet event recorder. FIG. **5** illustrates the Internet event recorder dialog window containing several individual event recording windows for programming the recording of several individual events. The dialog box of FIG. **5** allows the programming of recordings for multiple Internet events. These events could be available at different times and/or originate from different source web sites. Each dialog box, such as dialog box **502** for event **1**, in the multiple event recorder window **500** is substantially equivalent to dialog box **400** illustrated in FIG. **4**. FIG. **5** illustrates six such dialog boxes for the multiple event recorder **500**. However, it will be appreciated that any number of dialog boxes may be provided for the recording of multiple events. Each individual dialog box within the multiple event recorder allows the user to input the source, date, start/stop times, macros, and destinations for each of the individual events, as explained above with respect to FIG. **4**. In this case, a software routine is needed to prevent multiple programmed events from having the same scheduled recording period.

FIG. **6** is a flow chart illustrating the process of recording a transmitted Internet event according to one embodiment of the present invention. In step **602**, the user accesses the Internet event recorder program running on client computer **102**. If the Internet event recorder is implemented as a stand-alone program, it is accessed and executed according to the conventions of the operating system software on the client computer. If the Internet event recorder is implemented as a web browser extension, however, it typically may be accessed by typing the appropriate location address in the URL field **306** of the web browser, or by selecting an appropriate hypertext link button (e.g., link button **312** in FIG. **3**), depending on the conventions of the web browser being used.

In step **604** the user inputs the source URL, date, start and stop times, optional macro, and a destination descriptor in the appropriate fields of the dialog box, such as dialog box **400** illustrated in FIG. **4**. A general control method on the client computer may be available to review or cancel scheduled recordings, and to turn on or off the timer record mode, without requiring the user to bring up a web browser. At this point, user interaction with the event recorder ends, and the Internet event recorder automatically performs the recording functions.

On the date specified in field **406** and at the time specified in field **408**, the Internet event recorder commences a recording session. In step **606**, the Internet event recorder launches the specified web browser and dials up the Internet Service Provider. Once a network connection has been established, the Internet event recorder accesses the source URL specified in field **404** through the web browser, and executes any required macro. The macro to be executed is the key sequence or program stored in field **412** of dialog box **400**. It may occasionally occur that an ISP or source web site is unavailable, for example a source web site server may be busy or down at the time specified by the start time, or the source web site may have been moved. If the ISP or source web site is temporarily unavailable (such as if the telephone line to the server is busy) the web browser can be programmed to retry entry to the ISP or source site until access is successful, step **610**. If, however, a source web site is permanently unavailable, such as if the server has been taken off-line or the web address has changed because the web site has moved, the Internet event recorder will return an error message to the web browser indicating that a recording was not possible because of unavailability of the server web site. If an alternate ISP number or source URL has been provided, the alternate will be attempted before an error message is returned.

If the web site (or an alternate) is available, as determined in step **608** either upon an initial access attempt or a retried access attempt, the web server next determines the format of the source data, step **612**. Audio or video data may be made available by a server in several different forms. A common method is to simply store the data in memory as a data file. Such a file could contain the data to be transmitted in either standard data form or in compressed and/or encrypted form. The data on the web server could also be stored in a format which allows packetized bitstream downloading. Thus, in step **612** the web browser will determine the format in which the data is available. If in step **614** it is determined that the data is stored in a file, the Internet event recorder will commence downloading the file using the appropriate network protocol, such as the file transfer protocol (FTP), step **616**. The downloaded file will then be stored in a client file on a storage device such as a hard drive within or connected to the client computer, step **618**. After the download and storage process is complete, the Internet event recorder will then cause the web browser to disconnect from the source and the client computer to disconnect from the ISP, step **620**.

If it is determined in step **614** that the data is in the form of a digital bitstream which is simply provided or transmitted through the web server to be downloaded upon access by a client, the Internet event recorder will receive the data and direct the bitstream or signal to the destination device specified in field **414** of the Internet event recorder dialog box **400**. The Internet event recorder will continue to receive and direct the data stream to the appropriate destination device until the stop time (or duration) specified in field **410** of Internet event recorder dialog box **400** is reached, step **622**. At the time specified by the stop time or the limit of the specified recording duration, the Internet event recorder will stop downloading the data and cause the web browser to automatically disconnect from the source web site, step **624**. If no further Internet access is needed immediately, the client computer will then also disconnect from the ISP.

Upon disconnection from the source web site, a data log file associated with the recorded data event is stored in the appropriate memory device of the client computer **200** (e.g., mass storage device **207** or RAM **204**), step **626**. Such a log file allows the user to review recorded event information. The logged recording data could include the address of the source URL, the date of the recording and the start and stop times, the destination descriptor or file name, as well as any other data that might be available and beneficial to the user.

In one embodiment of the present invention, the destination of the event data will be a file stored on a storage device within or connected to the client computer. This will often be the case if the data to be recorded is a computer file downloaded through FTP, or a digital bitstream transmitted over the network. In this case, the destination will typically be a hard disk drive, such mass storage device **207** in client computer **200**, and the file name will be entered in field **414** of FIG. **4**.

If, however, the program is to be recorded to an external recording device rather than on a computer disk, the destination may be an analog or digital record and play back device. For example, for an audio signal, the destination may be an analog tape recorder or DAT (Digital Audio Tape) machine; and for a video signal, the destination may be a video cassette recorder (VCR). It is assumed that the appropriate recording device is connected to and controlled by the client computer through an appropriate interface, such as I/O interface **225**. In the case of an analog recording device, it is further assumed that the digital signal received over the network is converted to an analog signal prior to output through the I/O interface **225**. In this case, the program being recorded is the actual program data as played or as would be available on the client computer if the user were present at the time of the transmission.

In the case where the destination is a file stored on a hard disk drive, the user will access the file at a later time convenient to the user. In order to access and play back the data, it is typically necessary for the user to execute the same programs or plug-ins that are required when accessing the data from the server directly. Such plug-ins could include decryption and decompression programs. For example, if the data to be accessed is a video file which was compressed using the MPEG compression standard, the web browser would need to run an MPEG decompression plug-in in order to allow the user to view the program. Similarly, if the MPEG compressed data were transferred from the server through the recorder onto a file stored on a hard drive, upon subsequent playback of the file, the user would need to execute the MPEG decompression program to view the data as a video sequence.

In an alternative embodiment, the present invention may be designed to be configured by the user to access available scheduled programs through automatic "program guides" to the extent that such program guides are available through various Internet source sites. Such program guides could consist of codes which represent the location and time availability of particular Internet programs or events, and could be published or made available on-line from various Internet content providers. In this case, dialog box **400** could contain a single field for the program guide code instead of separate fields for the source URL, date, and start and stop times, or the entry fields could be automatically entered by simply making the desired program guide selection.

Recording an Internet event as described in the present disclosure provides not only for time-shifted viewing, but also allows a user to manipulate the data contained in the event. For example, to the extent allowed by the originator, the user may edit or caption a particular audio or video segment, or transform the format for reproduction in an alternate medium.

Internet Event Recorder Screen Authoring

In one embodiment of the present invention, the Internet Event Recorder screen and associated dialog boxes are created using standard HTML command structures. Option buttons and data entry fields may also be produced by constructing HTML objects and program links. Various different page formats may be utilized to achieve the present invention.

According to another embodiment, the Internet Event Recorder screen and associated dialog boxes could be produced using bit-mapped images or standard graphic format images, and displayed on a display device through a network interface, or over a broadcast signal. In such embodiments these screens need not be web pages accessed from the World-Wide Web using a web browser, but instead could be images of the type normally created, transmitted and displayed within the system in which the display device is typically used, such as a Local Area Network for a computer display.

In yet another embodiment, the Internet Event Recorder screen could be programmed into the display device as a built-in feature and accessed through a dedicated control button or on-screen menu, such as with the display controls for a television.

In the foregoing, a system has been described for automatically recording an audio/visual sequence transmitted over the Internet for display on a client computer. Although the present invention has been described with reference to specific exemplary embodiments, it will be evident that various modifications and changes may be made to these embodiments without departing from the broader spirit and scope of the invention as set forth in the claims. Accordingly, the specification and drawings are to be regarded in an illustrative rather than a restrictive sense.

What is claimed is:

1. A method for automatically storing data transmitted during a specified date and time of a limited duration over a network in a client system in communication with at least one source server, the method comprising the steps of:

providing one or more text entry fields for the entry of a source address, a date parameter, a first time parameter, and a second time parameter, said date parameter and first time parameter corresponding to the specified date and time the data is available over the network;

establishing a network connection between the client system and the source server;

accessing the source server specified by the source address, and downloading a data stream from the source server on the date specified by the date parameter and at the time specified by the first time parameter;

storing the data in a device coupled to said client system; and

stopping the downloading of the data stream at the time specified by the second time parameter.

2. A method according to claim **1** further comprising the step of disconnecting the network connection from the source server subsequent to the time specified by the second time parameter.

3. A method according to claim **1**, wherein the network is the Internet and the step of establishing a network connection includes the step of accessing an Internet Service Provider network server coupled to the client computer, and.

4. A method according to claim 1 further comprising the step of providing a destination text entry field for the entry of a destination descriptor, wherein the data stream is stored in the device specified by the destination descriptor.

5. A method according to claim 1 further comprising the step of providing a command field for entry of a command sequence specifying commands or user information required to access the data stream from the source server.

6. A method according to claim 3 wherein the date, the first time parameter, and the source address are specified in a program guide code, the program guide code providing a mechanism for automatically accessing the source of a program to be recorded at the time and date on which the program is available.

7. A method according to claim 4 wherein the destination descriptor specifies a file in a memory coupled to the client system.

8. A method according to claim 4 wherein the destination descriptor specifies an electronic recording device coupled to the client system.

9. A method according to claim 1 wherein the one or more text entry fields are contained within a text entry area displayed on a display device coupled to the client system, and the text entry area is a graphic image stored in a memory coupled to the client computer.

10. A method according to claim 3 wherein the one or more text entry fields are contained within a text entry area displayed on a display device coupled to the client system, and the text entry area is provided through an interactive display environment including World-Wide Web content, and the control screen and text entry areas are hypertext markup language (HTML) objects, and the method further comprises the step of executing a web browser program on the client computer.

11. An apparatus for automatically storing data transmitted over a network in a client system, said data available on a specified date and during a specified time of a limited duration, said client system in communication with at least one remote server system, the apparatus comprising:

means for providing a source field for entry of a source address;

means for providing a date field for entry of a date parameter of when the data is available:

means for providing a first time field for entry of a first time parameter, wherein the time entered in the first time field occurs during the day specified by the date parameter and when the data is available;

means for providing a second time field for entry of a second time parameter;

means for providing a destination field for entry of a destination descriptor; and

means for processing the date parameter, the source address, the first time parameter, the second time parameter, and the destination descriptor entered into their respective fields, wherein the processing is operable to transfer a data stream available at an address specified in the source field to an address specified in the destination field during the time specified in the first time parameter and the second time parameter.

12. An apparatus according to claim 11 further comprising means for providing a command field for entry of one or more commands or user information parameters required to access the data stream provided by the source specified in the source field.

13. An apparatus according to claim 12 wherein the date field, the source field, the first time field, the second time field, and the destination field are provided in a text entry field displayed on a display device coupled to the client system.

14. An apparatus according to claim 13 wherein the text entry field is contained within a control screen displayed on the display device, and the control screen and text entry field are graphic images stored in a memory coupled to the client computer.

15. An apparatus according to claim 13 wherein the text entry field is contained within a control screen displayed through an interactive display environment including World-Wide Web content, and wherein the control screen and text entry field are hypertext markup language objects.

16. A computer comprising:

a processor;

an input/output circuit coupled to the processor;

a display device coupled to the processor;

a network interface device coupled to the processor, the network interface device capable of being coupled to a server computer through a network medium; and

a memory coupled to the processor, the memory having contained therein sequences of instructions which, when executed by the processor, cause the processor to perfornn the steps of:

displaying a text entry field on the display device;

receiving a source address entered in the text entry field;

receiving a date parameter entered in the text entry field, said date parameter corresponding to when data is available at the source address, said data available during a specified time of a limited duration;

receiving a first time and a second time entered in the text entry field said first time corresponding to when data is available at the source address;

receiving a destination descriptor entered in the text entry field;

automatically accessing a source server specified by the source address by establishing a network connection over the network medium between the computer and the server computers and downloading a data stream from the source server at the first time;

storing the data in a device specified by the destination descriptor;

stopping the downloading of the data from the source server at the second time; and

disconnecting from the source server subsequent to the second time.

17. A computer according to claim 16 wherein the memory further contains instructions which cause the processor to perform the step of receiving a command sequence entered in the text entry field.

18. A computer according to claim 16 wherein the network medium is part of the Internet and the memory further contains instructions which cause the processor to perform the steps of:

accessing an Internet Service Provider network server coupled to the computer prior to the step of accessing the source server, and

disconnecting from the Internet Service Provider network server after disconnecting from the source server.

19. A computer according to claim 16 wherein the device specified by the destination descriptor is a storage device coupled to the processor.

20. A computer according to claim 16 wherein the device specified by the destination descriptor is an electronic recording device coupled to the processor through the input/output circuit.

21. A computer according to claim 16 wherein the text entry field is provided on a control screen through a display environment, and the control screen and text entry fields are graphics objects stored in a memory coupled to the processor.

22. A computer according to claim 18 wherein the text entry field is provided on a control screen through an interactive display environment including World-Wide Web content, and the control screen and text entry fields are hypertext markup language objects.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,012,086
DATED : January 4, 2000
INVENTOR(S) : Richard W. Lowell

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In column 2 at line 21 delete "companying" and insert --accompanying--

In column 10 at line 67 delete "computer, and." and insert --computer.--

In column 12 at line 29 delete "performn" and insert --perform--

Signed and Sealed this

Twenty-seventh Day of March, 2001

Attest:

Attesting Officer

NICHOLAS P. GODICI

Acting Director of the United States Patent and Trademark Office

US006381748B1

(12) **United States Patent**
Lin et al.

(10) **Patent No.: US 6,381,748 B1**
(45) **Date of Patent: Apr. 30, 2002**

(54) **APPARATUS AND METHODS FOR NETWORK ACCESS USING A SET TOP BOX AND TELEVISION**

(75) Inventors: **Eric Lin**, Westwood; **Howard S. K. Wan**, Lexington, both of MA (US)

(73) Assignee: **GTE Main Street Incorporated**, Wilmington, DE (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **08/853,035**

(22) Filed: **May 2, 1997**

(51) **Int. Cl.**[7] **H04N 7/173**
(52) **U.S. Cl.** **725/109**; 725/116
(58) **Field of Search** 725/74, 78, 82, 725/105, 109, 138, 85, 110, 111, 112, 113, 114, 115, 116, 117, 118, 131, 135, 139; 709/217-219

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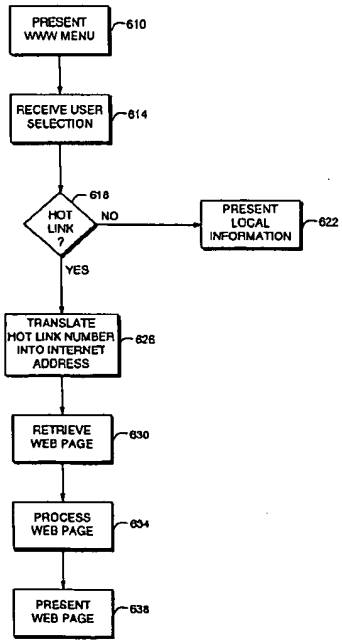
* cited by examiner

Primary Examiner—John W. Miller
(74) *Attorney, Agent, or Firm*—Leonard Charles Suchyta

(57) **ABSTRACT**

An Internet gateway video server transmits selection information to a set top box connected to a television. The set top box displays the selection information on the television. A user views the selection information, and inputs user selection requests to the set top box. The Internet gateway video server receives user the requests for information and retrieves the information. The server then converts the network information from a network format to a television format. The conversion includes scanning the network information for selection elements, and adding selection elements for transmission in the television format. The converted network information is then transmitted to the set top box for display on the television. The user may then make further selections based on the displayed network information.

36 Claims, 6 Drawing Sheets



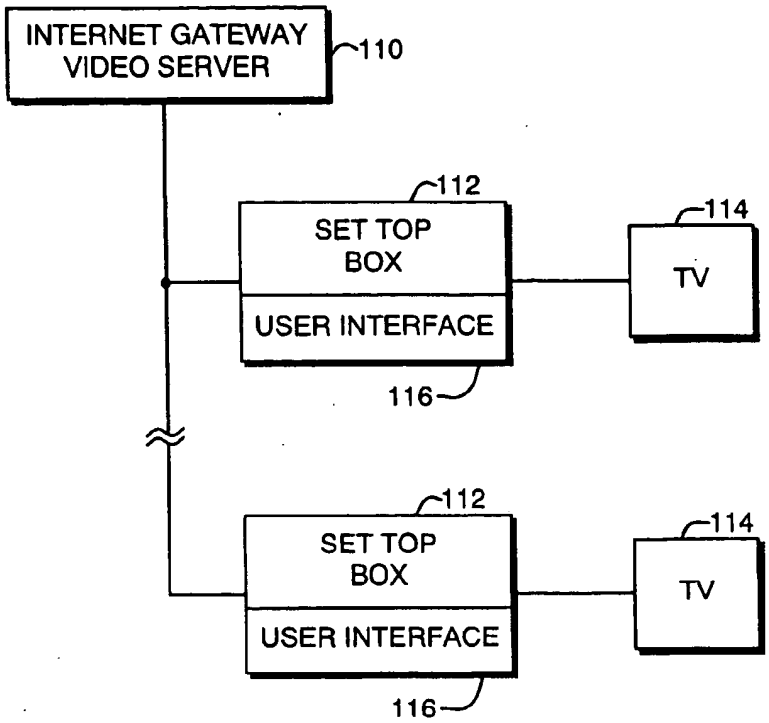

INTERNET GATEWAY VIDEO SERVER
110
112
SET TOP BOX
USER INTERFACE
116
114
TV
112
SET TOP BOX
USER INTERFACE
116
114
TV

FIG. 1

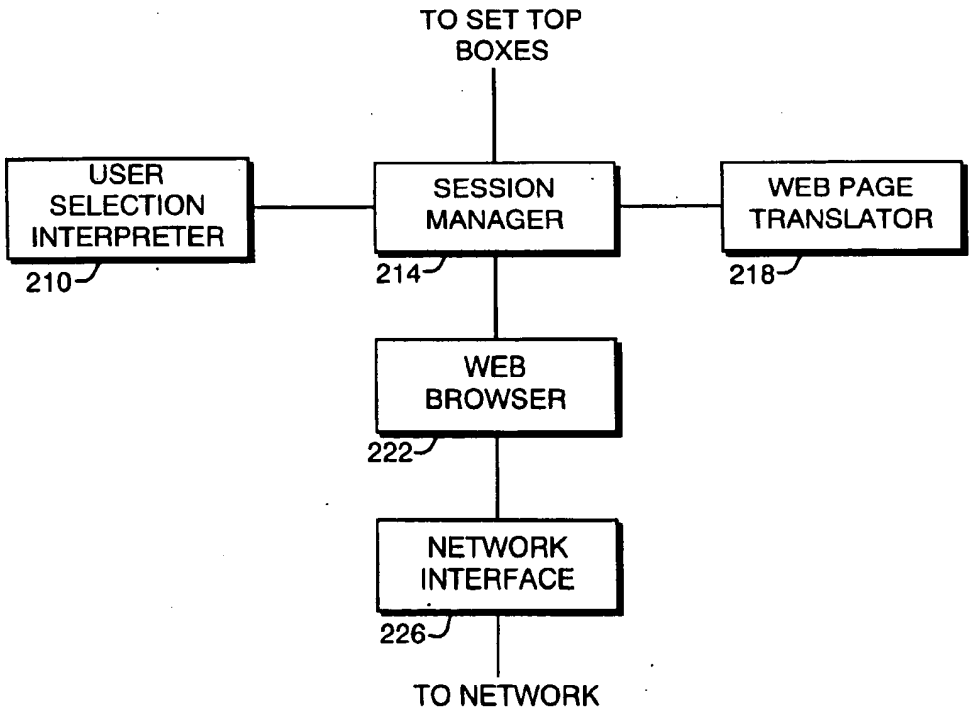

TO SET TOP BOXES
USER SELECTION INTERPRETER
210
SESSION MANAGER
214
WEB PAGE TRANSLATOR
218
WEB BROWSER
222
NETWORK INTERFACE
226
TO NETWORK

FIG. 2

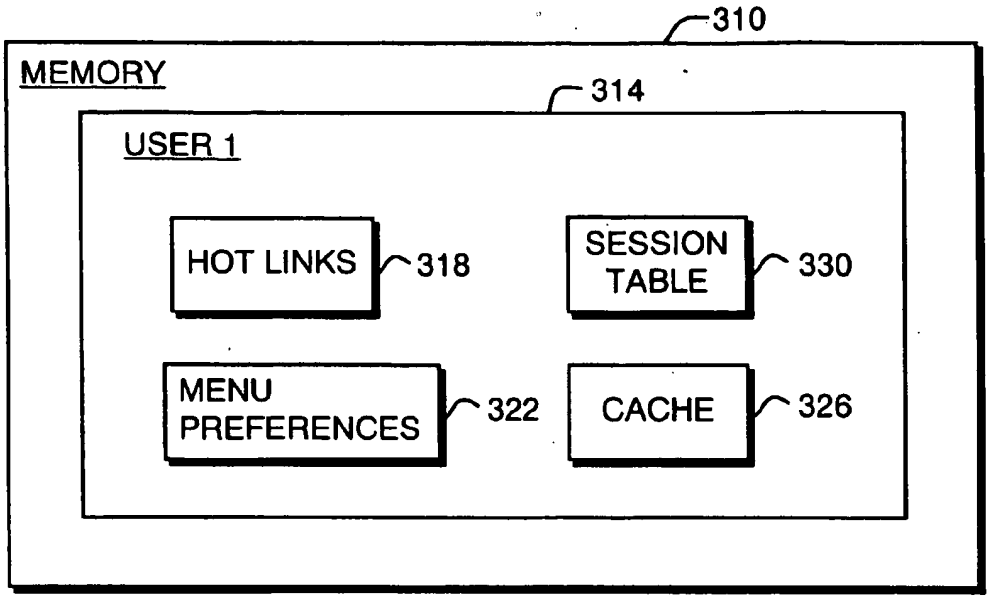

310
MEMORY
314
USER 1
HOT LINKS
318
SESSION TABLE
330
MENU PREFERENCES
322
CACHE
326

FIG. 3

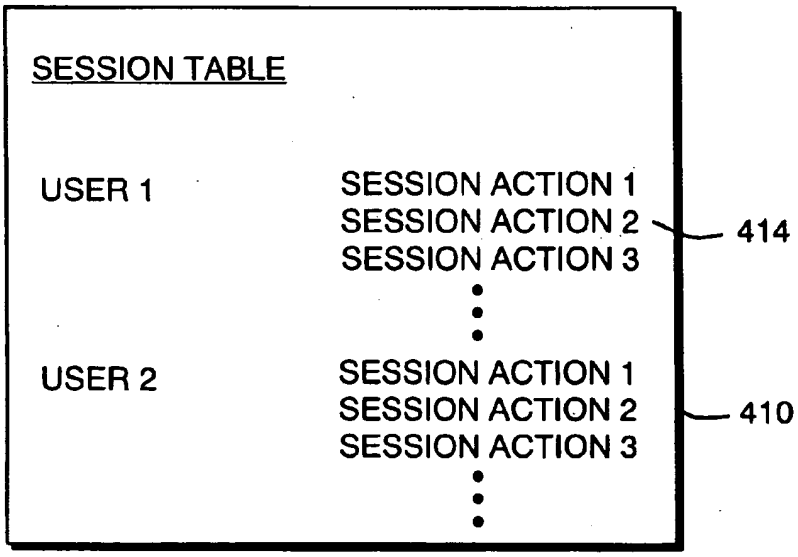

SESSION TABLE
USER 1
SESSION ACTION 1
SESSION ACTION 2
SESSION ACTION 3
414
USER 2
SESSION ACTION 1
SESSION ACTION 2
SESSION ACTION 3
410

FIG. 4

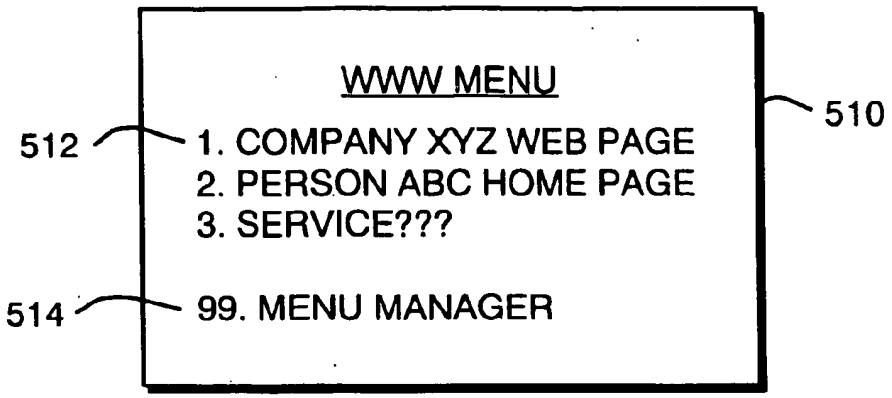

WWW MENU
1. COMPANY XYZ WEB PAGE
2. PERSON ABC HOME PAGE
3. SERVICE???
99. MENU MANAGER
510
512
514

FIG. 5

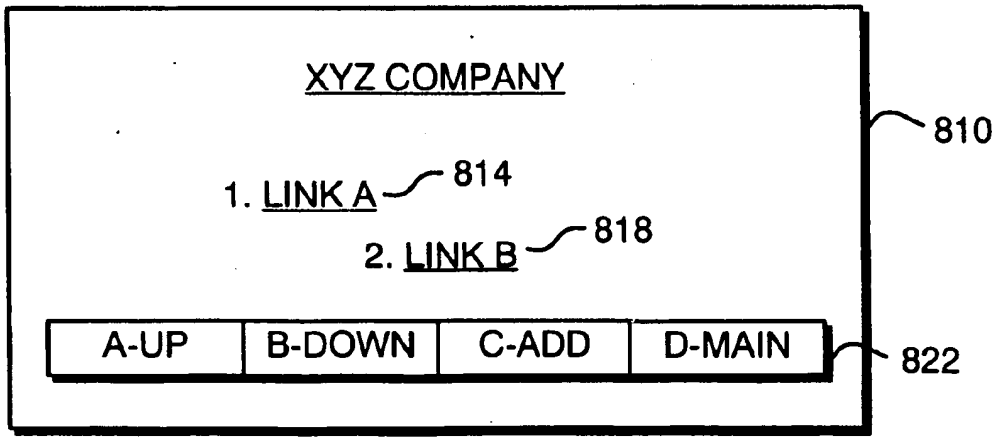

XYZ COMPANY
1. LINK A
2. LINK B
814
818
A-UP
B-DOWN
C-ADD
D-MAIN
810
822

FIG. 8

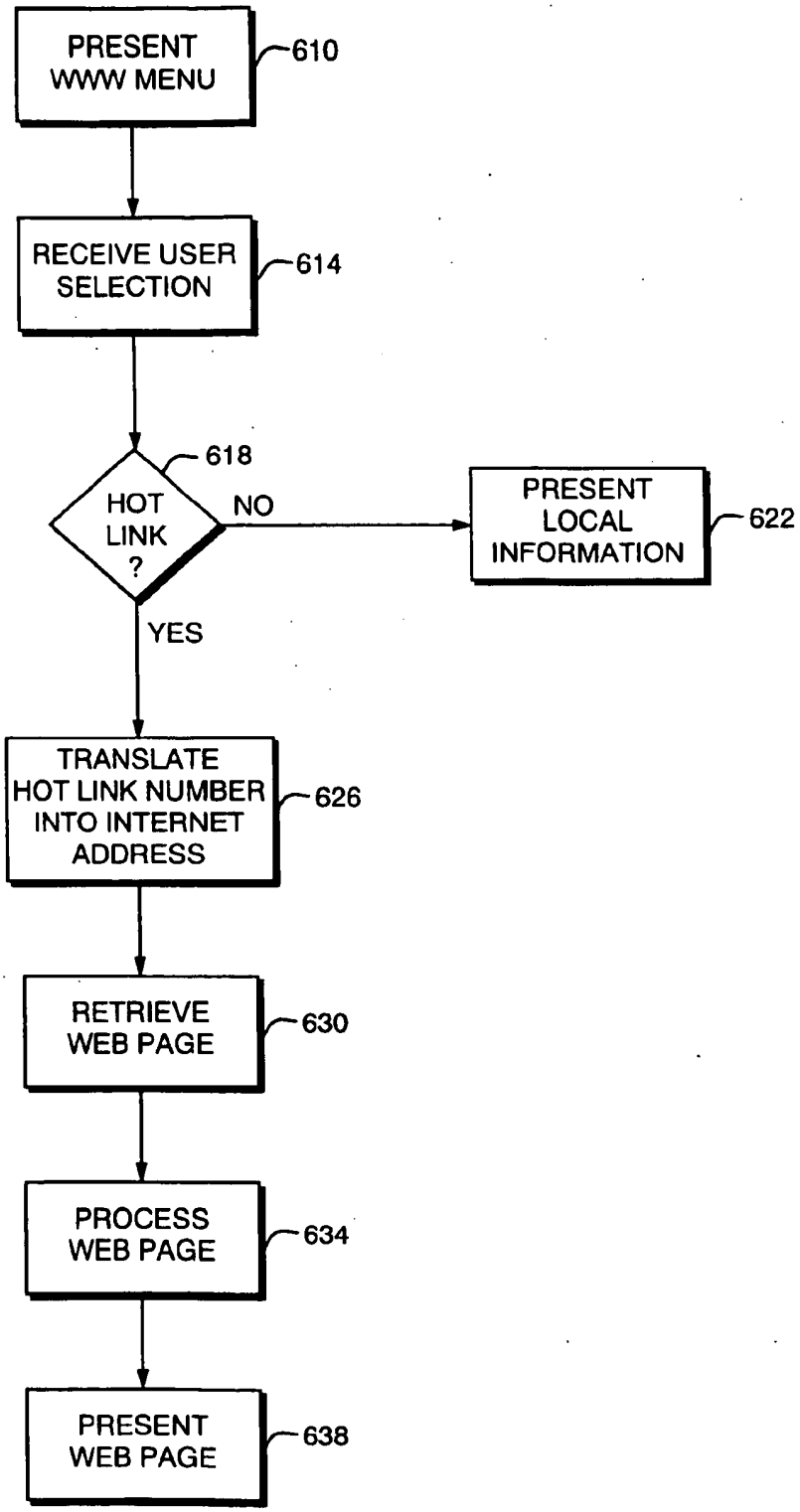

PRESENT WWW MENU
610
RECEIVE USER SELECTION
614
618
HOT LINK ?
NO
PRESENT LOCAL INFORMATION
622
YES
TRANSLATE HOT LINK NUMBER INTO INTERNET ADDRESS
626
RETRIEVE WEB PAGE
630
PROCESS WEB PAGE
634
PRESENT WEB PAGE
638

FIG. 6

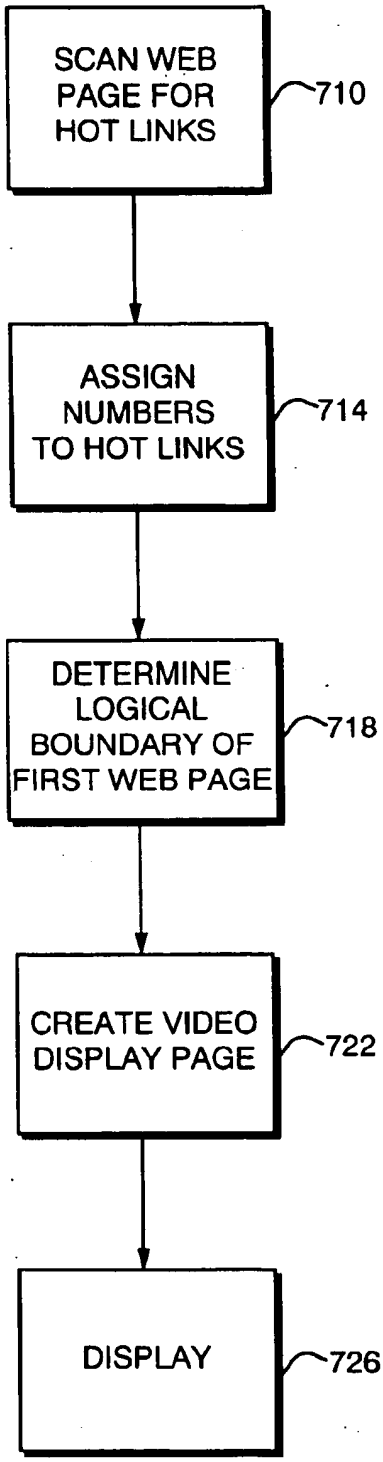

SCAN WEB PAGE FOR HOT LINKS
710
ASSIGN NUMBERS TO HOT LINKS
714
DETERMINE LOGICAL BOUNDARY OF FIRST WEB PAGE
718
CREATE VIDEO DISPLAY PAGE
722
DISPLAY
726

FIG. 7

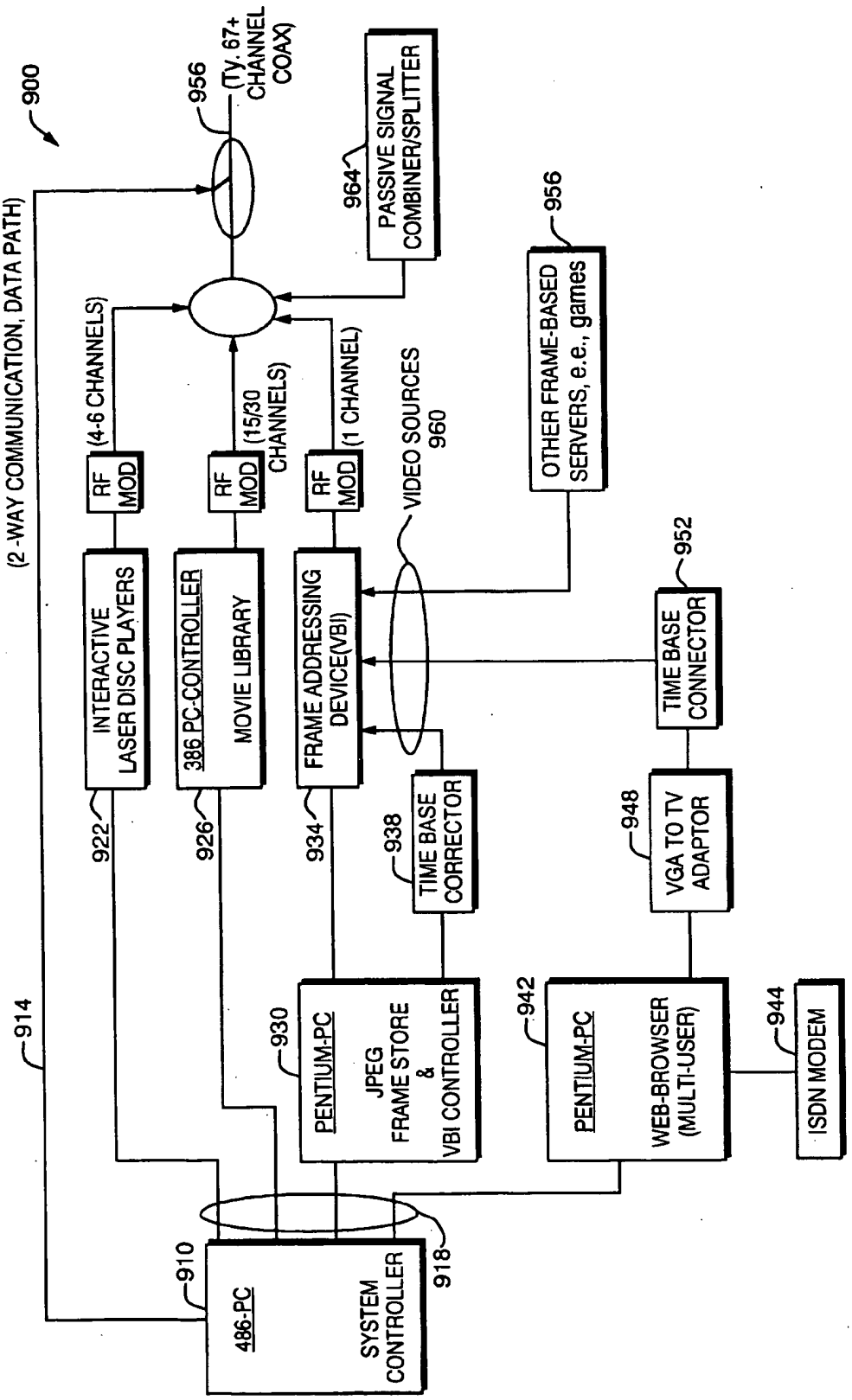

900
956
(TV, 67+ CHANNEL COAX)
964
PASSIVE SIGNAL COMBINER/SPLITTER
956
OTHER FRAME-BASED SERVERS, e.e., games
(2-WAY COMMUNICATION, DATA PATH)
(4-6 CHANNELS)
(15/30 CHANNELS)
(1 CHANNEL)
VIDEO SOURCES 960
RF MOD
RF MOD
RF MOD
INTERACTIVE LASER DISC PLAYERS
386 PC-CONTROLLER
MOVIE LIBRARY
FRAME ADDRESSING DEVICE(VBI)
952
TIME BASE CONNECTOR
922
926
934
938
TIME BASE CORRECTOR
948
VGA TO TV ADAPTOR
914
930
PENTIUM-PC
JPEG FRAME STORE & VBI CONTROLLER
942
PENTIUM-PC
WEB-BROWSER (MULTI-USER)
944
ISDN MODEM
910
486-PC
SYSTEM CONTROLLER
918

FIG. 9

APPARATUS AND METHODS FOR NETWORK ACCESS USING A SET TOP BOX AND TELEVISION

I. BACKGROUND OF THE INVENTION

A. Field of the Invention

The present invention relates generally to accessing a network, and in particular to apparatus and methods for accessing a network using the television as a display device.

B. Description of the Prior Art

A typical home computer today is comprised of hardware and software. The hardware includes a processor, hard drive, modem, monitor, RAM, keyboard, and mouse. The software includes an operating system and application programs. For many users the processing power of a home computer is more than sufficient to meet their needs. Home computers are used in a variety of ways. Many users use word processing and spreadsheet applications, while others perform tasks that require more significant processing power, such as graphics processing. More and more are using their computers to access the Internet, and in particular the World Wide Web (WWW).

Users connect to the Internet and the WWW using a modem. The modem is typically a 28.8 bps modem, and each computer is equipped with a Web browser. The user runs the Web browser, which provides a graphical interface for retrieving Web pages. Once the Web browser is up and running, the user requests the Web browser to retrieve a particular Web page. Most Web browsers allow a user to maintain a "hotlist" of "hotlinks" (i.e., bookmarks) to favorite Web sites. The hotlist is typically implemented as a pull down menu containing Web site addresses previously saved by the user.

The user provides an address to the Web browser using either the hotlist or by typing the address in by hand. The address identifies a Web page location. The Web browser then connects to the network (if not already connected), and retrieves the Web page at the address.

Once a Web page is retrieved it is presented to the user. The user may request further Web pages by selecting a hyperlink on the retrieved page, or by inputting another Web page address. The user selects hyperlinks by manipulating an input device, typically a mouse. The mouse is the primary input device for Web browser, and some of the mouse selections may be supplemented by simple text operations and use of the "Enter" key.

For many people, the cost of a home computer or similar hardware (e.g., a unit(s) including both a television and components of a home computer) is prohibitive, or impractical for their needs. Even for those who have computers, however, Internet access can often be frustratingly slow. Users are usually constrained by modem speeds which make Internet access slow. Faster access could be provided over T1 or ISDN lines, but the costs of such lines is usually prohibitive for most users.

Therefore, while many are interested in the WWW, they cannot justify buying a computer for this purpose alone. Other who can justify the cost can not justify the cost of connecting to a high speed line.

II. SUMMARY OF THE INVENTION

The present invention relates to apparatus and methods for accessing a network, such as the WWW, using a television and low cost set top box. It should be understood that while the discussion below discusses the invention in terms of the Internet, it is also contemplated that the principles described herein could also be applied to other networks, such as intranets.

A preferred embodiment of the invention is an apparatus for retrieving and retransmitting data processing network information in response to a user selection request. The apparatus comprises means for transmitting first selection information to be displayed on a monitor; means for receiving a user selection request based on the transmitted first selection information; means for retrieving data processing network information, in a network format, corresponding to the user selection request; means for transforming the data processing network information from the network format having a first interactive element to a monitor format having a second interactive element; and means for transmitting the data processing network information in the monitor format to the monitor.

Additional objects and advantages of the invention will be set forth in part in the description which follows, and in part will be obvious from the description, or may be learned by practice of the invention. The objects and advantages of the invention will be realized and attained by means of the elements and combinations particularly pointed out in the appended claims.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention, as claimed.

III. BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and together with the description, serve to explain the principles of the invention. In the drawings:

FIG. 1 is a block diagram showing a preferred embodiment of the invention;

FIG. 2 shows the general architecture of the server in accordance with a preferred embodiment of the invention;

FIG. 3 is a block diagram showing a portion of memory in the server;

FIG. 4 is a block diagram showing a session table stored at a server in accordance with a preferred embodiment of the invention;

FIG. 5 is an example of a menu which may be used in a preferred embodiment;

FIG. 6 is a flow chart showing the overall processing performed by a server in accordance with a preferred embodiment;

FIG. 7 is a flow chart showing the processing performed in transforming a Web page into information appropriate for display on a television;

FIG. 8 shows a display screen of a typical Web page on a television; and

FIG. 9 is a block diagram showing a preferred embodiment of the invention used in a multiple video source environment.

IV. DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference will now be made in detail to the present preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

FIG. 1 is a block diagram showing a preferred embodiment of the invention. Televisions **114** are connected to set top boxes **112** which send video signals to television **114**. Set top boxes **112** are also connected to Internet gateway video server **110** via a television distribution system, and receive frames from Internet gateway video server **110** for display on television **114**. Each set top box **112** is individually addressable, and sends information to server **110** which identifies the particular source set top box **112**.

In a preferred embodiment, server **110** is located at source end of a television signal, such as a cable system. For example, server **110** may be located at the headend of a television distribution system. Alternatively, server **110** may be located at some other location on the television distribution line. For example, server **110** may be located in an apartment building or hotel between an incoming television distribution line and set top boxes **112**. In this manner, "local" Internet access is provided. Moreover, server **110** may perform functions in addition to providing Internet access. For example, server **110** may be dedicated to providing Internet access to set top boxes **112**. Alternatively, server **110** may also receive a regular television distribution signal for transmission to set top boxes **112**, and provide Internet-related signals or other programming, depending upon the channel selection by the user.

Set top box **112** also receives and responds to signals from user interface **116**. The signals may be communicated to Internet gateway video server **110**. In a preferred embodiment, user interface **116** comprises an infrared remote control interface for receiving signals from a remote control device (not shown). User interface **116** may comprise any Well known user interface capable of providing selection signals to set top box **112**.

Internet gateway video server **110** receives signals from set top box **112** and responds to the signals by (1) interacting with the Internet, or (2) sending video signals for processing by set top box **112** for display on television **114**. Server **110** is connected to a high-speed communication line, such as a T1 or ISDN line. Server **110** transmits information generated locally by server **110**, or information received from the Internet, to television **114**. Server **110** also performs housekeeping functions, such as logging time, in response to information received from the network and signals received from set top box **1 12**.

Set top box **112** may process the information received from server **110**, or send it directly to television **114**. A user views information displayed on television **114** and, using user interface **116**, inputs selection information based on what is displayed. Some or all of the user selection signals may be transmitted by set top box **112** to the Internet gateway video server **110**. Signals sent from set top box **112** to server **110** include an identification of the set top box **112** and the user selection. Other information may also be provided depending upon the particular implementation of the set top box **112** and server **110**.

In response to the user selection signals, server **110** either prepares information locally and transmits the information to set top box **112**, or accesses the network for the information requested in the user selection signals. Set top box **112** may process some or all of the user selection signals. For example, set top box **112** may alter the display, and send notification of this change to server **110**.

Set top box **112** may be implemented in accordance with the principles similar to those set forth in U.S. Pat. No. 4,780,758 to Lin et al., which is hereby incorporated by reference. The box **112** may be implemented with a built in frame store which continually refreshes the television. A simple set top box **112** may perform little or no processing at all, acting as merely a sample and hold device for the server **110**.

FIG. 2 shows the general architecture of the server **110** in accordance with a preferred embodiment of the invention. Session manager **214** manages the overall information flow within server **110**. This includes reception of user selection signals from the set top boxes **112**, translations of user request signals, requests for Web pages, translation of Web pages, and transmission of television information to set top boxes **112**. In general, session manager **214** keeps track of requests from the user, requests to the web browser, menu presentation, and web page presentation. Session manager **214** receives information from the cable and transmits information to the cable.

In response to user selection signals, session manager **214** either responds directly to the user selection signals or requests translation of the user selection signals by user selection interpreter **210**. Interpreter **210** translates user selection signals into Web page addresses. The Web page addresses are sent to manager **214**.

In response to the translation, session manager **214** requests Web browser **222** to retrieve a Web page from the network via network interface **226**. Once the Web page has been received, it is sent to session manager **214**, which requests translation of the Web page by web page translator **218**. After translation, the results are transferred to manager **214**. Manager **214** then passes at least part of the translated Web page to the set top box **112** associated with the user request.

Session manager **214** keeps track of the multiple users requesting information via the set top boxes **112**. User requests are logged and tracked, and presentation information for each set top box **112** is managed in response to the user requests. This may require caching of particular display information to optimize response time to user requests. In summary, session manager **214** and Web browser **222** together form a multi-user Web browser capable of simultaneously managing multiple user sessions on multiple set top boxes **112**.

FIG. 3 is a block diagram showing a portion of memory **310** in session manager **214**. Server **110** implements a single- or multi-user browser system which manages the menus, hotlinks, and Web pages for each user in the system. Each user, therefore, has a dedicated memory area **314** which contains preselected hotlink information **318**, menu preferences **322**, and a cache or buffer area **326** for storing information flowing between the network, the Internet gateway video server **110**, and the set top box **112** or television **114**. For example, cache **326** may contain several of the pages most recently displayed on television **114**, as well as the most likely pages to be displayed in the near future. In one embodiment, a user session table **330** is also stored in the dedicated memory area. User session table **330** tracks each interaction with a particular set top box **112**.

The system may be implemented by having a single centralized cache for all users. In this way, the cache may contain frequently used pages for all users. Each time a request is made for a Web page the cache is checked before the Web page is retrieved. In this embodiment, it is preferable to have a time out mechanism for the cache to remove old Web pages which may have become stale. Similarly, a single user session table **330** for all users could be used, as discussed in greater detail below with respect to FIG. **4**.

In another preferred embodiment, hotlinks are not stored for later use. Each time a user logs on they are presented

with the same predefined menu. The predefined menu may be unique to that user, or the same menu may be presented to all users. This embodiment is simpler because hotlinks are not stored for later use. Yet another preferred embodiment has a combination of predefined menus, identical each time they are presented to the user, and user-defined menus which a particular user may create and alter according to that user's own preferences.

Menu preferences **322** include user-selectable options regarding the content of a main menu (see FIG. **5**) and certain features of how Web pages are to be displayed. For example, in addition to preselected favorite Web sites, a user may request that menus be created dynamically according to the time of day, as well as with respect to the profile of the user. This allows menus to be tailored to the particular timing and content needs of the user.

FIG. **4** is a block diagram showing some of the information stored by session manager **214** in server **110**. In particular, FIG. **4** shows a session table **410** maintained by server **110** storing information for each user for each active session in progress. Each user entry **414** contains information regarding information from a user and information sent to a user during each session. In this manner, server **110** knows exactly the state of each user during a particular session. This information may be discarded when the session ends. Alternatively, the information may be used by server **110** to develop user profile information for later use.

FIG. **5** is a display screen **510** showing a menu used in one preferred embodiment. Display screen **510** is generated locally by server **110**. The menu may provide a visual display of previously selected user hotlinks **512**. The menu may also include system management options, represented by a menu manager selection **514**. In another embodiment, display screen **510** contains the same choices, or a mix of same choices and user-defined choices, each time it is presented. For example, the menu may offer a certain number of predefined services subscribed to by a user. Alternatively, the choices may be predefined by a service provider in accordance with various subscriber plans.

A user inputs one of the displayed selection numbers into an infrared remote control which transmits selection signals to set top box **112**. As described above, set top box **112** and server **110** respond accordingly based on the user selection signals. The main menu shown in FIG. **5** may also include other user selectable options related to the general operation of the Internet gateway video server **110** and set top box **112**.

FIG. **6** is a flow chart showing the overall processing performed by server **110**. The user is first presented with a menu (step **610**). A user selection from the menu is then received (step **614**). The user selection will either be a Web page request requiring Web access (step **618**), or a selection which requires that information be generated locally by Internet gateway video server **110** and sent to the appropriate set top box **112** (step **622**). Locally generated information may include, for example, menus and administrative information related to a user's service.

If the user selects a WWW page, the user Web page selection is translated into an Internet address (step **626**). Server **110** retrieves the Web page associated with the translated Internet address (step **630**). The Web page is then processed to transform the Web-based format into signals suitable for display on television **114** (step **634**). The processed Web page is then transmitted to television **114** via set top box **112** and displayed to the user (step **638**).

Alternatively, the Web-based information could be delivered directly to set top box **112** for conversion into television signals at the set top box **112**. This would relieve the load of server **110**, but require much greater processing power in the set top box **112**.

FIG. **7** is a flow chart showing the processing performed in transforming a Web page into a table of information which is used to develop signals appropriate for display on television **114** (FIG. **6**, step **634**). The Web page is first scanned to determine the hyperlinks in the page (step **710**). For example, in the WWW environment, which typically utilizes HyperText Markup Language (HTML), the Web page is scanned for tags indicating references to hyperlinks.

If a hyperlink is detected, information such as a number, letter or symbol, is inserted into the HTML page near the hyperlink, thus assigning numbers or other symbols to hyperlinks (step **714**). When the HTML page is later converted into RGB computer graphics, and subsequently into NTCS format, the inserted information will also be translated into visual indicia corresponding to the hyperlink. For example, when the first hyperlink is detected a "1" might be inserted into the HTML document near the first hyperlink. When the second hyperlink is detected a "2" is inserted into the HTML document. Therefore, the original contents of the HTML document are augmented with additional visual indicia corresponding to each hyperlink.

The information developed from the scan of the Web page is also used to form a table that contains the correspondence between the inserted information and the associated hyperlink. The table is used to translate requests received from the user into hyperlink information.

The HTML document is then converted into RGB computer graphics, and subsequently translated into NTSC format, as is understood in the art. This process may include translation of graphics information into a format suitable for display on the television. For example, fonts and font sizes may be translated.

The Web page is then logically divided into a first display page in accordance with the size of the television display screen (step **718**). From this translated information and division into a logical display page, a video display appropriate for television **114** is created (step **722**). Finally, the translated Web page is displayed (step **726**). Because an entire Web page may not be displayable on a single television screen, the user may scroll or page through the Web page by requesting server **110** for further scrolled or paged portions of the page.

The information defining the correspondence between hyperlinks in the retrieved Web page and the select information which is displayed is used later to translate the user selection information back into a hyperlink, or network location. The session manager ensures that the appropriate data structures for creating user selections and translating them back into hyperlinks is available to the system processes which utilize these data structures.

FIG. **8** shows an example display screen of a Web page on a television in accordance with a preferred embodiment. In the example, display **810** shows a Web page for the XYZ Company. Hyperlinks **814** and **818** have an appearance similar to the format and placement of the original Web page from which it was generated. Note, however, that the television display screen has numbers corresponding to each hyperlink, as denoted by numerals "1" and "2". The user may input these numerals into the infrared remote as selection signals which are sent to the set top box **112** and/or server **110**.

In this manner, the user input operates to select information in a manner similar to selection of a hyperlink as

normally used in computer-generated Web pages. Note also option bar **822** which presents navigation options to the user. The navigation options allow a user to move to other areas of the currently displayed Web page (denoted by "A" and "B"), add the current Web page as a new hotlink selection to the main menu shown in FIG. **5** (denoted by "C"), and return to the main menu (denoted by "D"). The menu presented to the user may change dynamically in accordance with the current state of the session. For example, if the session is occurring at a particular time, the menu may change to present different selections corresponding to the particular time. This information may be kept in the user menu preferences area, or by server **110**, depending on the nature of the changes.

FIG. **8** may take other forms as well. For example, instead of using numbers and letters for user-selectable options, iconic symbols or other selectable visual indicia may be used.

In response to a user selecting one of the hyperlinks using a device such as a remote control, a signal is sent by user interface **116** to set top box **112**, which processes the signal, sends a signal to server **110**, or both responds to the signal and passes it on. In response to a user selection of a particular hyperlink, server **110** sets up a network connection to retrieve the selected Web page. In response to a user selecting one of the option bar **822** options, a signal is sent in a similar manner to server **110** via set top box **112**. In this instance, however, information is generated locally by Internet gateway video server **110** for display on TV **114**. Alternatively, the set top box **112** may handle the response to the menu option bar **822**.

FIG. **9** is a block diagram showing a preferred embodiment of the invention used in a server headend. FIG. **9** shows a headend coaxial cable system **900** for providing various types of user-selectable video programming over a coaxial channel. A preferred embodiment of the invention using the principles described above is implemented primarily by system controller **910**, Pentium PC **942**, VGA to TV adapter **948**, time base corrector **952**, frame addressing device **934**, and the two-way communication data path **914** between system controller **910** and coaxial cable **956**. System controller **910** may be implemented using a 486-based PC. System controller **910** communicates over coaxial cable **956** via two-way data communications path **914**.

System controller **910** also communicates with several of the system elements via control and communication lines **918**. Control and communication lines **918** may be implemented, for example, using an RS-232 type interface. System controller **910** controls interactive laser disc players **922**, movie library **926**, JPEG frame store and VBI controller **930**, and Web browser **942**. JPEG frame store and Vertical Blanking Interval (VBI) controller **930** and Web browser **942** place information on the coaxial cable via frame addressing device (VBI) **934**. In this embodiment, Web browser **942** carries out the functions of session manager **214** and Web browser **226** of FIG. **2**. Each of interactive laser disc player **922**, movie library **926**, and frame addressing device **934** send signals through a respective RF modulator onto the coaxial cable **956** via passive signal combiner/splitter **964**.

Web browser **942** sends signals to VGA to TV adaptor **948**, which in turn sends signals to time base corrector **952** for transmission to frame addressing device **934**. VGA to TV adaptor **948** converts computer output data into NTSC scan lines. The adaptor may be implemented using, for example, a Magnicorder® device. Time base corrector **952** may be implemented using, for example, a Hotronics® time base corrector, or similar device.

Similarly, JPEG frame store and VBI controller **930** sends signals to time-base corrector **938**, which in turn sends signals to frame addressing device **934**. Frame addressing device **934** also receives control signals from JPEG frame store and VBI controller **930**. Finally, frame addressing device **934** receives signals from other frame-based servers, such as video games, indicated generally by **956**. In summary, frame addressing device transmits signals from multiple video sources, indicated generally by **960**.

In accordance with a preferred embodiment of the present invention, a user sends selection signals to a set top box **112** which are, in turn, transmitted on coaxial cable **956**, via two-way communication data path **914**, to system controller **910**. Controller **910** takes the user selection signals and processes them to control the various video sources of information. With respect to the preferred embodiment, system controller **910** sends selection signals to Web browser **942**, which initiates retrieval of the requested Web page via ISDN modem **944**.

Although FIG. **9** demonstrates the invention being used in coordination with multiple other sources of video, headend **900** could merely comprise a multi-user web browser which responds to user requests for WWW information.

V. CONCLUSION

The present invention thus allows multiple users to access the Internet, or other networks, via a high speed channel using only a set top box **112** and television. It provides users with a variety of advantages. For example, users no longer must have a personal computer in their home to access the Internet. The invention also allows users to access the WWW from their television sets. The only costs associated with such an architecture are those of the set top box **112** and remote. Homes with cable TV already require similar devices. The present invention also circumvents the need to interact with the menus and WWW using a mouse tethered to a device. Users can view the WWW with the ease of a remote control. Various modifications and variations can be made in the set top box **112** of the present invention and in construction of this server without departing from the scope or spirit of the invention.

Other embodiments of the invention will be apparent to those skilled in the art from consideration of the specification and practice of the disclosed embodiments. The specification and examples are exemplary only, and the true scope and spirit of the invention is defined by the following claims and their equivalents.

We claim:

1. Apparatus for retrieving and retransmitting data processing network information in response to a user selection request, comprising:

means for transmitting first selection information to be displayed on a television;

means for receiving a user selection request based on the transmitted first selection information;

means for retrieving data processing network information, in a network format, corresponding to the user selection request;

means for transforming the data processing network information from the network format having a first interactive element to a television format having a second interactive element; and

means for transmitting the data processing network information in the television format to the television.

2. The apparatus of claim 1, wherein the means for transforming includes:

means for scanning the retrieved data processing network information to identify second selection information as the first interactive element; and

transforming the data processing network information by creating television information having third selection information corresponding to the second interactive element.

3. The apparatus of claim 1, wherein the first selection information comprises a menu, and wherein the means for receiving a user selection request includes means for receiving a signal corresponding to a selection from the menu.

4. The apparatus of claim 3, further comprising means for customizing the menu.

5. The apparatus of claim 1, wherein the means for receiving a user selection request includes:

means for translating the user selection request into the network location.

6. The apparatus of claim 1, wherein the means for receiving a user selection request includes:

means for receiving signals from a set top box connected to the television.

7. The apparatus of claim 1, wherein the means for receiving a user selection request includes:

means for receiving signals from a distribution system.

8. The apparatus of claim 1, wherein the means for retrieving network information includes:

an interface to the Internet.

9. The apparatus of claim 1, wherein the means for retrieving network information includes:

means for managing multiple user sessions.

10. The apparatus of claim 1, wherein the means for retrieving network information includes:

means for logging user session activity.

11. The apparatus of claim 1, wherein the means for retrieving network information includes:

means for caching network information.

12. The apparatus of claim 1, wherein the means for transmitting includes:

means for transmitting the television information over a television distribution system.

13. A method of retrieving and retransmitting data processing network information in response to a user selection request, comprising:

transmitting first selection information to be displayed on a television;

receiving a user selection request based on the transmitted first selection information;

retrieving data processing network information, in a network format, corresponding to the user selection request;

transforming the data processing network information from the network format having a first interactive element to a television format having a second interactive element; and

transmitting the data processing network information in the television format to the television.

14. The method of claim 13, wherein the step of transforming includes the substeps of:

scanning the retrieved data processing network information to identify second selection information as the first interactive element; and

transforming the data processing network information by creating television information having third selection information corresponding to the second interactive element.

15. The method of claim 13, wherein the first selection information includes a menu, and wherein the receiving a user selection request includes the substep of:

receiving a signal corresponding to a selection from the menu.

16. The method of claim 15, further comprising:

means for customizing the menu.

17. The method of claim 13, wherein the receiving a user selection request includes the substep of:

translating the user selection request into the network location.

18. The method of claim 13, wherein the receiving a user selection request includes the substep of:

receiving signals from a set top box connected to the television.

19. The method of claim 13, wherein the receiving a user selection request includes the substep of:

receiving signals from a distribution system.

20. The method of claim 13, wherein the retrieving network information includes the substep of:

interfacing to the Internet.

21. The method of claim 13, wherein the retrieving network information includes the substep of:

managing multiple user sessions.

22. The method of claim 13, wherein the retrieving network information includes the step of:

logging user session activity.

23. The method of claim 13, wherein the retrieving network information includes the substep of:

caching the network information.

24. The method of claim 13, wherein the transmitting includes the substep of:

transmitting the television information over a distribution system.

25. A system for retrieving data processing network information in response to a user selection request, and retransmitting the data processing network information to a set top box, comprising:

a set top box connected to a television for transmitting television information to the television and for transmitting user selection requests; and

means for retrieving data processing network information, comprising:

means for transmitting first selection information to the set top box for display on the television;

means for receiving a user selection request based on the transmitted first selection information;

means for retrieving data processing network information, in a network format having a first interactive element, corresponding to the user selection request;

means for transforming the data processing network information from the network format to a television format having a second interactive element; and

means for transmitting the data processing network information in the television format to the set top box for display on the television.

26. The apparatus of claim 25, wherein the means for transforming includes:

means for scanning the retrieved data processing network information to identify second selection information as the first interactive element; and

transforming the data processing network information by creating television information having third selection information corresponding to the second interactive element.

27. The apparatus of claim **25**, wherein the first selection information comprises a menu, and wherein the means for receiving a user selection request includes means for receiving a signal corresponding to a selection from the menu.

28. The apparatus of claim **27**, further comprising means for customizing the menu.

29. The apparatus of claim **25**, wherein the means for receiving a user selection request includes:

means for translating the user selection request into the network location.

30. The apparatus of claim **25**, wherein the means for receiving a user selection request includes:

means for receiving signals from a set top box connected to the television.

31. The apparatus of claim **25**, wherein the means for receiving a user selection request includes:

means for receiving signals from a distribution system.

32. The apparatus of claim **25**, wherein the means for retrieving network information includes:

an interface to the Internet.

33. The apparatus of claim **25**, wherein the means for retrieving network information includes:

means for managing multiple user sessions.

34. The apparatus of claim **25**, wherein the means for retrieving network information includes:

means for logging user session activity.

35. The apparatus of claim **25**, wherein the means for retrieving network information includes:

means for caching network information.

36. The apparatus of claim **25**, wherein the means for transmitting includes:

means for transmitting the television information over a television distribution system.

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